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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N74-13700* + National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A SPECIAL BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 35, SEPTEMBER 1973
Sep. 1973 180 p refs
(NASA-SP-7037(35)) Avail: NTIS HC $5.25 CSCL 01A

This special bibliography lists 614 reports, articles, and other documents introduced into the NASA scientific and technical information system in August 1973. Author

N74-13701 Maryland Univ., College Park.
ARTIFICIAL DEVELOPMENT OF AN ATMOSPHERIC BOUNDARY LAYER FLOW MODEL IN A WIND TUNNEL Ph.D. Thesis
Fredric Allen Godshall 1973 117 p
Avail: Univ. Microfilms Order No. 73-23725

A wind flow model of the atmospheric boundary layer may be produced in a wind tunnel. With the use of wind flow modulating devices placed in the tunnel entrance, a thick flow model may be produced at the entrance to the tunnel. Thus a long wind fetch in the tunnel is not needed to produce the thick boundary layer model. In this experiment a thermally stable boundary layer wind flow model was produced for the purpose of studying atmospheric diffusion. Hot wire anemometry and cold wire temperature measuring equipment are used to measure vertical heat and momentum flux in the model. These fluxes are used to compute a flux value for L which is found to be equal to the gradient determined value of L. The suitability of the model for study of atmospheric diffusion is demonstrated by this test of eddy flux in the model. Dissert. Abstr.

N74-13702 Notre Dame Univ., Ind.
THE DETERMINATION OF NON-SYMMETRIC VEHICLE STABILITY PARAMETERS FROM RESPONSE DATA Ph.D. Thesis
Robert John Lusardi 1973 145 p
Avail: Univ. Microfilms Order No. 73-24322

Methods are presented for the determination of the parameters of ordinary differential equations from response data. Application is made to the angular motion of a non-symmetric flight vehicle. In particular, the supposedly symmetric spinning body of revolution is investigated to show that those parameters which depend on the dynamic flow field are not governed by the symmetry assumption. Dissert. Abstr.

N74-13703# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
TURBULENCE MODELS AND THEIR EXPERIMENTAL VERIFICATION. 8: OPTICAL ANEMOMETRY
J. H. Whitelaw Apr. 1973 34 p refs
(HTS/73/23) Avail: NTIS HC $3.75

The use of optical anemometry for measuring various types of flows is discussed. The optical process is one in which the frequency shift of laser light is measured by Doppler effect. The relative advantages of the system are explained in relation to other types of measurement. The components of the system and the principles of operation are illustrated. Several signal processing systems are explained. The types of flows in which optical anemometry has been used are given as: (1) laminar pipe and separated flows, (2) turbulent duct flows, (3) turbulent jets, (4) supersonic flows, and (5) flames. Author

N74-13704# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
TURBULENT BOUNDARY LAYER SEPARATION AT MACH 12
C. Appels Sep. 1973 59 p refs
(TN-90) Avail: NTIS HC $5.00 CSCL 01A

Results are presented of an experimental investigation of turbulent boundary layer separation in a compression corner in hypersonic flow. The experiments were conducted at a Mach number of 12 and a unit Reynolds number of 3.66. Times 10 to the 7th power per meter. Pressure and heat transfer measurements were taken in both attached and separated flow regions, the latter being achieved for wedge angles greater than 30 deg. A study of the outboard three-dimensionality of the finite width separated region on the centerline measurement was made. Similar trends were found for the pressure and heat transfer distributions in both attached and separated flows. The non-dimensionalised separation length remained constant when changing the boundary layer thickness. Author

N74-13705*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A NEW TECHNIQUE FOR CALCULATING REENTRY BASE HEATING
James C. S. Meng (NAS-NRC) Washington Dec. 1973 49 p refs
(NASA-TN-D-7508; M-116) Avail: NTIS HC $3.00 CSCL 20D

The laminar base flow field of a two-dimensional reentry body has been studied by Telenin's method. The flow domain was divided into strips along the x-axis, and the flow variations were represented by Lagrange interpolation polynomials in the transformed vertical coordinate. The complete Navier-Stokes equations were used in the near wake region, and the boundary layer equations were applied elsewhere. The boundary conditions consisted of the flat plate thermal boundary layer in the forebody region and the near wake profile in the downstream region. The resulting two-point boundary value problem of 33 ordinary differential equations was then solved by the multiple shooting method. The detailed flow field and thermal environment in the base region are presented in the form of temperature contours, Mach number contours, velocity vectors, pressure distributions, and heat transfer coefficients on the base surface. The maximum

heating rate was found on the centerline, and the two-dimensional stagnation point flow solution was adquate to estimate the maximum heating rate so long as the local Reynolds number could be obtained. Author

N74-13706*# Scientific Translation Service, Santa Barbara, Calif.
THE INSTITUTE FOR FLIGHT MECHANICS, BRAUNSCHWEIG (081) AND STUTTGART (027)
Washington NASA Dec. 1973 69 p refs Transl. into ENGLISH from the German report
(Contract NASw-2483)
(NASA-TT-F-15197) Avail: NTIS HC $5.50 CSCL 01A

The Institute of Flight Mechanics of the DFVLR is engaged in theoretical and experimental works on the solution of flight dynamic problems predominantly in the field of aeronautics. In the field of flight dynamics of aircraft, emphasis is on the project of a variable stability aircraft using the HFB 320-S1 research aircraft. Thus important flight test data may be obtained for current research activities supporting the improvement of methods to predict aircraft performance and handling qualities. Further, emphasis is laid on investigations of rescue and recovery systems. Drop tests, model tests and theoretical investigations, run side by side, to approach the solutions of the numerous problems (such as function, dynamic behavior, strength). Finally, system analyses and system evaluations are performed with probabilistic and operations research methods in cooperation with other institutes. Author

N74-13707*# Kanner (Leo) Associates, Redwood City, Calif.
CALCULATION OF POTENTIAL FLOW ABOUT AXIALLY SYMMETRIC FUSELAGES, ANNULAR PROFILES AND ENGINE INLETS
W. Geissler Washington NASA Dec. 1973 16 p refs Transl. into ENGLISH from Z. Flugwissenschaften (West Germany), v. 20, no. 12, Dec. 1972 p 457-462
(Contract NASw-2481)
(NASA-TT-F-15213) Avail: NTIS HC $3.00 CSCL 01A

The calculation of the potential flow about bodies of revolution (closed bodies, inlets, cowls) is done by a method using surface distributions of sources, sinks, and vortices. This method deals with the case of an arbitrary flow about the body. Besides axisymmetric flows and flows at incidence to the body axis, it is possible to take care of the flow field induced by another bod (interference problem). A panel method is used for the numerical solution of the problem. In the case of an axisymmetric body, the surface elements are frustums of cones of small axial length. For different types of bodies the results of this method are compared with measurements. Author

N74-13708*# Avco Corp., Wilmington, Mass. Systems Div.
ANALYSIS OF STALL FLUTTER OF A HELICOPTER RADAR BLADE Final Report
Peter Crimi Washington NASA Nov. 1973 134 p refs Sponsored in part by USAAMRDL
(Contract NAS1-11378)
(NASA-CR-2322) Avail: NTIS HC $4.50 CSCL 01C

A study of rotor blade aeroelastic stability was carried out, using an analytic model of a two-dimensional airfoil undergoing dynamic stall and an elastomechanical representation including flapping, flapwise bending and torsional degrees of freedom. Results for a hovering rotor demonstrated that the models used are capable of reproducing both classical and stall flutter. The minimum rotor speed for the occurrence of stall flutter in hover, was found to be determined from coupling between torsion and flapping. Instabilities analogous to both classical and stall flutter were found to occur in forward flight. However, the large stall-related torsional oscillations which commonly limit aircraft forward speed appear to be the response to rapid changes in aerodynamic moment which accompany stall and unstall, rather than the result of an aeroelastic instability. The severity of stall-related instabilities and response was found to depend to some extent on linear stability. Increasing linear stability lessens the susceptibility to stall flutter and reduced the magnitude of the torsional response to stall and unstall. Author

N74-13709*# Advisory Group for Aerospace Research and Development, Paris (France).
DYNAMIC STALL
P. Crimi (Avco Corp., Wilmington, Mass.) and P. F. Yaggy, ed. (Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.) Nov. 1973 41 p refs Sponsored by NASA
(NASA-CR-136473; AGARD-AG-172) Avail: NTIS HC $4.25 CSCL 01A

Problems associated with unsteady stall are summarized and past experimental and theoretical studies, relating primarily to dynamic stall of helicopter rotor blades, are reviewed. The problems attendant to analytic treatment of dynamic stall, including identification of relevant flow elements and definition of unsteady separation, are then discussed, and the basis for a theory which accounts for viscous effects and viscous-inviscid interactions analytically is presented. Results of computations are compared with measured loading on an airfoil undergoing sinusoidal pitching motion. The amounts of lift overshoot and their variation with frequency are in good agreement. Analyses of wake-induced stall and stall flutter of a helicopter rotor blade are then presented. The results indicate that the large stall-related torsional oscillations which commonly limit helicopter forward speed are the response to rapid changes in aerodynamic moment which accompany stall and unstall, rather than the consequence of an aeroelastic instability. Author

N74-13710# Advisory Group for Aerospace Research and Development, Paris (France).
MAGNUS CHARACTERISTICS OF ARBITRARY ROTATING BODIES
I. D. Jacobson (Va. Univ.) and P. F. Yaggy, ed. (Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.) Nov. 1973 62 p refs
(AGARD-AG-171) Avail: NTIS HC $5.25

Theoretical and experimental investigations of the Magnus effect on arbitrary bodies of revolution are reviewed. The main emphasis is on spinning projectiles at angle of attack, both with and without fins. Flow visualization measurements are used to assess the accuracy of the existing theories. Laminar, turbulent, and mixed boundary layers are considered. Author

N74-13711# Sandia Labs., Albuquerque, N.Mex.
SUMMARY OF WIND TUNNEL DETERMINED AERODYNAMIC COEFFICIENTS FOR THE 155 mm XM549 PROJECTILE CONFIGURATION
G. G. Wilson Sep. 1973 41 p refs
(Contract AT(29-1)-789)
(SLA-73-607) Avail: NTIS HC $5.45

During Phase 2 studies for the development of a 155 mm Artillery-Fired Atomic Projectile (AFAP), it became apparent that in order to achieve a ballistic match between the AFAP and the standard HE projectile, the projectile's aerodynamic parameters must be well known. Wind tunnel tests were conducted to experimentally determine aerodynamic coefficients for the 155 mm XM549 projectile for a Mach number range of 0.5 to 2.46. Author (NSA)

N74-13712# Ballistic Research Labs., Aberdeen Proving Ground, Md.
AERODYNAMIC CHARACTERISTICS OF OGIVE OVERSIZE-HEAD CYLINDERS STABILIZED BY TAIL-MOUNTED, MULTIPLE FINS OR RING WINGS AT SUPERSONIC MACH NUMBERS
Klaus O. Opalka Jun. 1973 80 p refs
(DA Proj. 1T0-61102-A-33D)
(AD-768155; BRL-MR-2303) Avail: NTIS CSCL 19/1

Test data are reported for two ring-wing and two multiple-fin stabilizers mounted on the tail of a cylinder combined with ogive oversize heads of 1.38 caliber diameter and varying lengths. Wind tunnel tests were run at five (5) Mach numbers from 1.75 to 3.5 and the resulting aerodynamic coefficients are plotted versus angle of attack and Mach number. The results are discussed regarding their effects on the longitudinal stability for the various configurations. Author (GRA)

N74-14669 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 2: FLIGHT MECHANICS, FLIGHT CONTROL [FACHGEBIET 2: FLUGMECHANIK, FLUGFUEHRUNG]
In its DFVLR Annual Review, 1972 1972 p 95-149 refs In

GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N74-13713 West Virginia Univ., Morgantown.
THE STABILITY OF HELICAL VORTEX FILAMENTS IN THE WAKE OF A HOVERING ROTOR Ph.D. Thesis
Ojars Skujins 1973 130 p
Avail: Univ. Microfilms Order No. 73-23891

The geometry and stability of the wake of a hovering rotor out of ground effect was investigated. A schlieren system in conjunction with a high speed drum camera was developed for this purpose, so that real time sequence photographs could be taken of the vortex filaments as they were convected downstream, with rotor azimuth angle increments as small as 15 degrees being possible between exposures. Two, three and four bladed 16 inch diameter rotors were used operating at rotor speeds of up to 9000 RPM. The effects of the various rotor parameters, such as rotor speed, number of blades, and collective pitch, were correlated with the stability of the vortex wake system. Factors including vortex instability growth rate and modes of instabilities are discussed. Dissert. Abstr.

N74-13714 Georgia Inst. of Tech., Atlanta.
EFFECT OF COMPRESSIBILITY ON THREE-DIMENSIONAL HELICOPTER ROTOR BLADE FLUTTER Ph.D. Thesis
William Felton White 1973 94 p
Avail: Univ. Microfilms Order No. 73-22947

An analytical study is presented to determine a flutter criterion applicable to helicopter rotor blades. To accomplish this, it is necessary to establish the relative accuracy and computational efficiency of compressible unsteady aerodynamic theories applicable to rotor blades. Considerations are restricted to the classical flutter of an equivalent single rotor in hover at low inflow. Strip theory is used to compute aerodynamic loads. Comparison is made with experimental data. Dissert. Abstr.

N74-13715*# Stanford Univ., Calif. Guidance and Control Lab.
AUTOMATIC CONTROL OF A HELICOPTER WITH A HANGING LOAD
Narendra K. Gupta and Arthur E. Bryson, Jr. Jun. 1973 88 p refs
(Contract NAS2-5143)
(NASA-CR-136504; SUDAAR-459) Avail: NTIS HC$6.50 CSCL 01C

An autopilot logic is designed here for controlling a helicopter with a hanging load. A 16th order model for the system is decoupled into four subsystems: (1) a second order system for yawing motion, (2) a second order system for vertical motion, (3) a sixth order system for longitudinal motion, and (4) a sixth order system for lateral motion. A measuring scheme, which could be used in remote areas, is developed and filters are designed to estimate the state variables from these measurements. The autopilot can be used to move the load over short distances without retracting the cables. This is done by automatically shifting the autopilot modes from position-hold (hover) to acceleration-hold to velocity-hold (cruise) to deceleration-hold to velocity-hold (near hover) to position-hold (hover). Use of such an autopilot might save considerable turnaround time. The Sikorsky S-61 helicopter is chosen as an example vehicle. The performance of the controlled system is studied in the presence of longitudinal and lateral winds. Author

N74-13716# Cranfield Inst. of Technology (England). Coll. of Aeronautics.
PERFORMANCE CHARACTERISTICS OF SHORT HAUL TRANSPORT AIRCRAFT INTENDED TO OPERATE FROM REDUCED LENGTH RUNWAYS
D. Howe Apr. 1973 32 p refs
(CRANFIELD-AERO-18) Avail: NTIS HC $3.75

The design characteristics of future short haul transport aircraft intended to operate from runways of reduced length are compared to those used at the present time. The results show that it should be possible to design reduced take off and landing (RTOL) aircraft to operate safely from runways of 4000 ft length without the need for power augmented lift. Such an aircraft would operate at speeds very similar to those used by current short haul transports, the main difference being in the need to provide a static thrust/weight ratio of the order of 0.4. On the other hand short take off and landing (STOL) aircraft intended to operate from runways of about 2000 ft length require a substantial degree of powered lift both for take off and landing. Author

N74-13717*# Scientific Translation Service, Santa Barbara, Calif.
NEW TECHNOLOGIES AND PROFITABILITY OF HELICOPTERS
J. Andres Washington NASA Dec. 1973 54 p ref Transl. into ENGLISH of the paper presented at the AGARD Flight Mech. Panel Symp. Aircraft Design Integration and Optimization (Maignane, France), Oct. 1973 22 p
(Contract NASw-2483)
(NASA-TT-F-15195) Avail: NTIS HC $4.75 CSCL 01C

A study was conducted to determine the economic aspects of helicopter operation for commercial purposes. Concepts of specific cost and cost per kilogram provide the basis for the analysis. The fundamental characteristics of helicopters which determine its mission and profitability are discussed. Specific areas investigated are: (1) fatigue life of components, (2) noise reduction, (3) vibration reduction, (4) optimization of rotary wings, and (5) application of composite materials for helicopter construction. Author

N74-13718*# Boeing Co., Wichita, Kans.
THE INFLUENCE OF WING LOADING ON TURBOFAN POWERED STOL TRANSPORTS WITH AND WITHOUT EXTERNALLY BLOWN FLAPS Final Report
R. L. Morris, C. R. Hanke, L. H. Pasley, and W. J. Rohling Washington NASA Nov. 1973 165 p refs
(Contract NAS1-11370)
(NASA-CR-2320; D3-8514-7) Avail: NTIS HC $4.75 CSCL 01C

The effects of wing loading on the design of short takeoff and landing (STOL) transports using (1) mechanical flap systems, and (2) externally blown flap systems are determined. Aircraft incorporating each high-lift method are sized for field lengths of 2,000 feet, 2,500 feet, and 3,500 feet, and for payloads of 40, 150, and 300 passengers, for a total of 18 point-design aircraft. An assumed 1975 level of technology is applied to both concepts in terms of propulsion, weights, active controls, supercritical wing methodology, and acoustics. Low-wing-loading STOL configurations with mechanical flaps are found to be competitive with externally blown flap STOL configurations over wide ranges of payload and field length for the airworthiness rules and technology improvements assumed. Because the results of design studies like this one are sensitive to the ground rules assumed, careful attention is paid to describing the assumptions. These assumptions must be understood before the results are compared with other STOL airplane studies. Author

N74-13719*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC AND NOISE MEASUREMENTS ON A QUASI-TWO DIMENSIONAL AUGMENTOR WING MODEL WITH LOBE-TYPE NOZZLES
Thomas N. Aiken Sep. 1973 77 p refs
(NASA-TM-X-62237) Avail: NTIS HC $6.00 CSCL 01C

An investigation was made of the static, wind-on aerodynamic and static noise characteristics of an augmentor wing having lobe type nozzles. The study was made in the Ames 7-by 10-Foot No. 1 Wind Tunnel using a small-scale, quasi-two-dimensional model. Several configurations of lobe nozzles as well as a normal

slot nozzle were tested. Results indicate that lobe nozzles offer improved static and wind-on aerodynamics and reduced static noise relative to slot nozzles. Best wind-on performance was obtained when the tertiary gap was closed even though the static thrust augmentation was maximum with the gap open. Static thrust augmentation, wind-on lift and drag, and static noise directivity are presented as well as typical static and wind-on exit velocity profiles, surface pressure distributions and noise spectrums. The data are presented with limited discussion. Author

N74-13720*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TAKEOFF AND LANDING PERFORMANCE AND NOISE MEASUREMENTS OF A DEFLECTED SLIPSTREAM STOL AIRPLANE WITH INTERCONNECTED PROPELLERS AND ROTATING CYLINDER FLAPS
James A. Weiberg, Demo Giulianetti, Bruno Gambucci, and Robert C. Innis Dec. 1973 58 p refs
(NASA-TM-X-62320) Avail: NTIS HC $5.00 CSCL 01C

A YOV-10A aircraft was modified to incorporate rotating cylinder flaps and interconnected propellers with Lycoming T-53-L11 engines. Flight tests were made to evaluate the low speed handling qualities and performance characteristics. The flight test results indicated that landings could be made with approach speeds of 55 to 65 knots (CL = 4.5) and descent angles of 6 deg to 8 deg for total flap angles of 60 deg to 75 deg. At higher flap angles, deterioration of stability and control characteristics precluded attempts at landing. The noise level on the ground under an 8 deg landing approach path was below 86 PNdB at distances beyond 1 nautical mile from touchdown. Takeoffs were made with 30 deg to 45 deg flaps at lift off speeds of 75 to 80 knots and climb angles of 4 deg to 8 deg. Noise levels were below 83 PNdB at 3.5 nautical miles from the start of ground roll. Author

N74-13721*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND TUNNEL INVESTIGATION OF A LARGE-SCALE 25 DEG SWEPT-WING JET TRANSPORT MODEL WITH AN EXTERNAL BLOWING TRIPLE-SLOTTED FLAP
Kiyoshi Aoyagi, Michael D. Falarski, and David G. Koenig Nov. 1973 59 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-62197) Avail: NTIS HC $5.00 CSCL 01C

An investigation has been conducted to determine the aerodynamic characteristics of a large-scale subsonic jet transport model with an externally blown triple-slotted flap. The lift of the model was augmented by the turbofan engine exhaust impingement on the flap surface. The model had a 25 deg swept wing of aspect ratio 7.28 and four turbofan engines. The model was tested with two flap extents. One extended from 0.11 to 1.00 of the wing semispan, and the other extended from 0.11 to 0.75 of the wing semispan with a single-slotted aileron from 0.75 to 1.00 of the wing semispan. The results were obtained for several flap deflections with and without the horizontal tail at gross thrust coefficients from 0 to 4.0. Longitudinal and lateral data are presented with three and four engines operating. Author

N74-13722*# Giravions Dorand Co., Suresnes (France).
MARCH 1971 WIND TUNNEL TESTS OF THE DORAND DH 2011 JET FLAP ROTOR, VOLUME 1 Final Report
Marcel Kretz, Jean-Noel Aubrun, and Marc Larche Jun. 1973 55 p refs 2 Vol.
(Contract NAS2-3673)
(NASA-CR-114693; DH-2011-D-E5-Vol-1) Avail: NTIS HC $4.75

The results of wind tunnel tests, second series of tests performed in the NASA Ames 40 x 80 foot wind tunnel, of the DH 2011 jet-flap rotor are presented and analyzed. The tests have been focused on multicyclic effects and the capability of this rotor to reduce the vibratory loads and stresses in the blades. The reductions of the vibrations and stresses at tip speed ratio of 0.4 have attained 50%. The theory shows further reductions possible, reaching 80%. The results show that the performance characteristics after the modifications introduced since 1965 remained unchanged. The domain of investigation has been enlarged to include the tip speed ratios of 0.6 and 0.7. To analyze the complex aeroelastic phenomena a new analytical technique has been utilized to represent the mathematical model of the rotor. This technique, based on transfer matrices and transfer functions, appears very simple and it is believed that this analysis is applicable to many kinds of investigations involving large numbers of variables. Author

N74-13723*# Giravions Dorand Co., Suresnes (France).
MARCH 1971 WIND TUNNEL TESTS OF THE DORAND DH 2011 JET FLAP MOTOR, VOLUME 2 Final Report
Marcel Kretz, Jean-Noel Aubrun, and Marc Larche Jun. 1973 151 p Sponsored in part by Army Air Mobility Lab. 2 Vol.
(Contract NAS2-3673)
(NASA-CR-114694; DH-2011-D-E5-Vol-2) Avail: NTIS HC $9.75 CSCL 01C

Wind tunnel tests were conducted of the Dorand DH 2011D jet flap rotor. The data recorded during the tests consist of: (1) multicyclic cam coefficients, (2) stress analysis, (3) vibratory loads, (4) Fourier analysis of flap deflection, and (5) blade bending stress. Data are presented in the form of tables and graphs. Author

N74-13724*# Boeing Co., Wichita, Kans.
DEVELOPMENTAL DESIGN, FABRICATION, AND TEST OF ACOUSTIC SUPPRESSORS FOR FANS OF HIGH BYPASS TURBOFAN ENGINES
R. H. Tucker, M. D. Nelsen, G. E. Gregg, and F. I. Palmer Washington NASA Jan. 1974 63 p refs
(Contract NAS3-14321)
(NASA-CR-2338; D3-8952) Avail: NTIS HC $3.50 CSCL 01C

An analysis procedure was developed for design of acoustically treated nacelles for high bypass turbofan engines. The plan was applied to the conceptual design of a nacelle for the quiet engine typical of a 707/DC-8 airplane installation. The resultant design was modified to a test nacelle design for the NASA Lewis quiet fan. The acoustic design goal was a 10 db reduction in effective perceived fan noise levels during takoff and approach. Detailed nacelle designs were subsequently developed for both the quiet engine and the quiet fan. The acoustic design goal for each nacelle was 15 db reductions in perceived fan noise levels from the inlet and fan duct. Acoustically treated nacelles were fabricated for the quiet engine and quiet fan for testing. Performance of selected inlet and fan duct lining configurations was experimentally evaluated in a flow duct. Results of the tests show that the linings perform as designed. Author

N74-13725*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT STUDY OF A VEHICLE OPERATIONAL STATUS AND MONITORING SYSTEM
James E. Love, William J. Fox (Lockheed-Calif. Co.), and Edward J. Wicklund (Honeywell, Inc.) Washington Jan. 1964 12 p
(NASA-TN-D-7546; H-789) Avail: NTIS HC $2.75 CSCL 01C

An analog onboard monitoring system was installed on a YF-12 airplane as the first phase of a program to monitor the engine inlet and portions of the airplane's electrical and fuel management subsystems in flight. The system provided data which were considered to form a suitable base for diagnostic test logic and decision criteria for the rest of the program. The data were also adequate for the purpose of maintaining the engine inlet and identifying malfunctions within it. The investigation showed that the requirements of an onboard monitoring system should be considered during the original design of the system to be monitored. Author

N74-13726*# Hamilton Standard, Windsor Locks, Conn.
Q-FANSTM FOR GENERAL AVIATION AIRCRAFT
Rose Worobel and Millard G. Mayo Dec. 1973 267 p refs
(Contract NAS2-6834)
(NASA-CR-114665) Avail: NTIS HC $15.50 CSCL 01C

Continued growth of general aviation over the next 10 to 15 years is dependent on continuing improvement in aircraft safety, utility, performance and cost. Moreover, these advanced aircraft will need to conform to expected government regulations controlling propulsion system emissions and noise levels. An

attractive compact low noise propulsor concept, the Q-FANTM when matched to piston, rotary combustion, or gas turbine engines opens up the exciting prospect of new, cleaner airframe designs for the next generation of general aviation aircraft which will provide these improvements and meet the expected noise and pollution restriction of the 1980 time period. New Q-FAN methodology which was derived to predict Q-FAN noise, weight and cost is presented. Based on this methodology Q-FAN propulsion system performance, weight, noise, and cost trends are discussed. Then the impact of this propulsion system type on the complete aircraft is investigated for several representative aircraft size categories. Finally, example conceptual designs for Q-FAN/engine integration and aircraft installations are presented. Author

N74-13727*# Boeing Vertol Co., Philadelphia, Pa.
V/STOL TILT ROTOR AIRCRAFT STUDY. VOLUME 10: PERFORMANCE AND STABILITY TEST OF A 1-14.622 FROUDE SCALED BOEING VERTOL MODEL 222 TILT ROTOR AIRCRAFT (PHASE 1)
F. J. McHugh, W. Eason, H. R. Alexander, and H. Mutter Oct. 1973 521 p refs 10 Vol.
(Contract NAS2-6598)
(NASA-CR-114603; D222-10053-1-Vol-10) Avail: NTIS HC $28.25 CSCL 01C

Wind tunnel test data obtained from a 1/4.622 Froude scale Boeing Model 222 with a full span, two prop, tilt rotor, powered model in the Boeing V/STOL wind tunnel are reported. Data were taken in transition and cruise flight conditions and include performance, stability and control and blade loads information. The effects of the rotors, tail surfaces and airframe on the performance and stability are isolated as are the effects of the airframe on the rotors. Author

N74-13728# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
CONTROL CONFIGURED VEHICLE RIDE CONTROL (CCV RCS). B-52 CONTROL SYSTEM ANALYSIS, SYNTHESIS, AND DESIGN Technical Report, Dec. 1971 - Jan. 1973
C. R. Stockdale and R. D. Poyneer Jul. 1973 223 p refs
(AF Proj. 487T)
(AD-767590; AFFDL-TR-73-83) Avail: NTIS CSCL 01/2

The Control Configured Vehicle Ride Control System Program was conducted to demonstrate the capability of significantly improving the ride quality of a large flexible airplane and lengthening its structural life. The ride control system employs both horizontal and vertical canards to be installed and flight tested on the B-52 LAMS vehicle. The analysis, design, and flight demonstration of the ride control system was directed toward one discrete flight condition, low level, high speed. The ride control system was designed to reduce pilot station acceleration while flying through atmospheric turbulence.
Author (GRA)

N74-13729# Little (Arthur D.), Inc., Cambridge, Mass.
FAILURE ANALYSIS OF HELICOPTER EXTERNAL CARGO-HANDLING SYSTEMS Final Report
Robert E. Hunt Jun. 1973 168 p refs
(Contract DAAJ02-72-C-0063; DA Proj. 1F1-62203-AA-33)
(AD-767254; ADL-C-74645; USAAMRDL-TR-73-44) Avail: NTIS CSCL 01/3

A study of the failure of helicopter cargo-handling systems was conducted. A data search and compilation were completed from which the external cargo-handling system was defined and the system operation explained. Operational parameters were also defined and explained. Also criteria for assessing failures were established, data sources were cited, a search plan outlined, and failure data and consensus data were retrieved and categorized. The data were taken primarily from cargo helicopters deployed in Vietnam. Their overall utilization, load categories, and rigging materials were determined, and a consensus summary of the cause of specific failures was compiled and documented. A data analysis was conducted with the relationship of failure occurrences and rates determined for specific types of accidents and failures. Predominant causes of failures were analyzed, a cost/value of relationship of cargo dropped established, and projections of the heavy-lift helicopter as a cargo carrier were made. Candidate corrective actions were recommended, with the development of specific corrective actions made, encompassing a collapsible cargo net-pallet concept and an investigation of cargo hook design principles. Author (GRA)

N74-13730# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
NOISE GENERATION BY CYLINDRICAL SPOILERS IMMERSED IN AN AIR DUCT Interim Technical Report
T. M. Tower, Edelbert G. Plett, H. H. Chiu, and Martin Summerfield Mar. 1973 255 p refs
(Contract N00014-67-A-0151-0029)
(AD-767336; AMS-1092) Avail: NTIS CSCL 01/3

The report describes a study concerned with the effect of thin cylindrical flow spoilers upstream of the exit plane of a constant-area duct on the acoustic power output and directivity patterns of the noise field external to the duct. Spoilers of diameter 1/16, 5/32, and 3/16 in. were placed at 1/8 in. and 11 in. from the exit plane of a 1 in. diameter duct. Far-field sound pressure levels were measured in an anechoic chamber over a mean velocity range of 250 to 900 ft/s. The frequency range of the investigation was 200 Hz to 50 kHz, while the Reynolds number range, based on mean velocity upstream of the spoiler and on spoiler diameter, was 8000 to 80,000. (Modified author abstract) GRA

N74-13731# Systems Associates, Inc., Long Beach, Calif.
US ARMY HELICOPTER HYDRAULIC SERVOCYLINDER RELIABILITY AND MAINTAINABILITY INVESTIGATION Final Report
James L. Huffman and Sheldon Dockswell May 1973 148 p refs
(Contract DAAJ02-71-D-0003; DA Proj. 1F1-62205-A-119)
(AD-767243; SAI-R73-009; USAAMRDL-TR-73-29) Avail: NTIS CSCL 13/7

The report describes an investigation carried out to identify, isolate, and verify the causes of problems with hydraulic servocylinder actuators used on U.S. Army helicopters, and to trace the resulting effects on helicopter availability. Design requirements, quality assurance provisions, maintenance procedures and practices were analyzed to assess their impact upon the current problems. The analysis of the pertinent failure data and documentation revealed that five failure modes were responsible for over 90% of the total hydraulic servocylinder removals in a 6 1/2-year period. Subsequent analysis of the various policies, practices and procedures showed that these documents contain anomalies that contribute to the occurrence of the five predominant failure modes. The lack of stringent basic design requirements, quality control, and adequate maintenance manuals was shown to be a major contributor to the leaking failure mode. This mode accounts for approximately half of the servocylinder removals from U.S. Army helicopters.
Author (GRA)

N74-13732# Boeing Vertol Co., Philadelphia, Pa.
TRANSMISSION THERMAL MAPPING (CH-47C FORWARD ROTOR TRANSMISSION) Final Report
Rocco C. Tocci, A. J. Lemanski, and Nelson J. Ayoub May 1973 170 p refs
(Contract DAAJ02-72-C-0075; DA Proj. 1G1-62207-AA-72)
(AD-767875; D210-10545-1; USAAMRDL-TR-73-24) Avail: NTIS CSCL 01/3

The report presents the results of tests conducted to obtain the thermal maps of a CH-47C helicopter forward rotor transmission. The tests were conducted at several torque levels and to several controlled oil-out target temperatures. Thermal growth between selected points on the transmission case was measured and analyzed. Author (GRA)

N74-13733# General Dynamics/Convair, San Diego, Calif.
STOL TACTICAL AIRCRAFT INVESTIGATION. VOLUME 2: DESIGN COMPENDIUM Final Report, 7 Jun. 1971 - 31 Jan. 1973
J. Herbert, Jr., E. S. Levinsky, J. C. Ramsey, E. C. Laudeman, and H. G. Altman May 1973 273 p refs
(Contract F33615-71-C-1754; AF Proj. 643A)
(AD-767561; GDCA-DHG73-001-Vol-2; AFFDL-TR-73-21-Vol-2) Avail: NTIS CSCL 01/1

The design compendium presents methods for estimating

the aerodynamic and stability and control characteristics of mechanical flaps and the three lift/propulsion systems: mechanical flaps plus vectored thrust, externally blown flaps, and internally blown flaps. A review of various theoretical approaches is presented to form a basis for the generalized methods that are developed to estimate lift, drag, pitching moment, downwash, and the lateral-directional stability derivatives. Sample problems are presented to allow the most advantageous utilization of the methodology. The data correlations shown at the end of the major sections verify and substantiate the selected approaches. A general methodology has been developed for predicting the low speed aerodynamic and stability characteristics of STOL transport aircraft. The methodology is applicable to the EBF, IBF, and MF/VT STOL concepts. The basic procedures, which predict the lift curve versus angle of attack, maximum lift coefficient, induced drag, thrust recovery, pitching moment, and downwash angle are easily hand-calculated for a single case or programmed on a small computer to calculate a large number of configurations. Author (GRA)

N74-13734# General Dynamics/Convair, San Diego, Calif.
STOL TACTICAL AIRCRAFT INVESTIGATION. VOLUME 4: WIND TUNNEL DATA ANALYSIS Final Report, 7 Jun. 1971 - 31 Jan. 1973
J. Herbert, Jr., J. C. Ramsey, E. C. Laudeman, C. A. Whitney, and N. A. Pondmareff May 1973 406 p refs
(Contract F33615-71-C-1754; AF Proj. 643A)
(AD-767363; GDCA-DHG73-001-Vol-4;
AFFDL-TR-73-21-Vol-4) Avail: NTIS CSCL 01/3

Force and rake information measured during 1087 hours of low speed wind tunnel testing conducted by Convair Aerospace are summarized. Over 2730 data runs were generated on 242 major configuration variables that covered the following lift/propulsion concepts: mechanical flaps plus vectored thrust, externally blown flaps, and internally blown flaps. Lift data was reduced into three basic terms: power-on to power-off lift curve slope ratio, trailing edge flap lift increment at alpha = zero degrees, and maximum lift coefficient increment due to the application of power. These relationships were evaluated as a function of blowing momentum coefficient and correlated for the effects of configurational variations (wing planform, leading and trailing edges, and nacelle location). Drag data was reduced into the form of induced drag factor, minimum profile drag, thrust recovery and then analyzed as a function of blowing momentum coefficient. The pitching moment data analysis compares the flap pitching moment increment among the various configurations. (Modified author abstract) GRA

N74-13735# General Dynamics/Convair, San Diego, Calif.
STOL TACTICAL AIRCRAFT INVESTIGATION. VOLUME 5: FLIGHT CONTROL TECHNOLOGY Final Report, 7 Jun. 1971 - 31 Jan. 1973
J. Hebert, Jr., G. Campbell, E. Price, L. B. White, and R. Aalstenberg May 1973 347 p refs
(Contract F33615-71-C-1754; AF Proj. 643A)
(AD-767364; GDCA-DHG73-001-Vol-5;
AFFDL-TR-73-21-Vol-5) Avail: NTIS CSCL 01/3

Flight control studies conducted during the STOL Tactical Aircraft Investigation by Convair Aerospace were directed toward development of flight control systems for three versions of the medium STOL transport. Baseline vehicles used for flight control studies were: externally blown flap, internally blown flap, and mechanical flap/vectored thrust configurations. Requirements of MIL-F-8785B and MIL-F-833000 for aircraft handling qualities were the guiding criteria for the control system study. The mechanization trade study concluded that fly-by-wire mechanization is preferred over the more mechanical version which requires significant fly-by-wire features to achieve the required augmentation and decoupling. (Modified author abstract) GRA

N74-13736# General Dynamics/Convair, San Diego, Calif.
STOL TACTICAL AIRCRAFT INVESTIGATION. VOLUME 6: AIR CUSHION AND GROUND MOBILITY STUDY Final Report, 7 Jun. 1971 - 31 Jan. 1973
J. Herbert, Jr., H. Weber, G. T. Draper, C. Kerr, Jr., and T. F. Reid May 1973 43 p refs
(Contract F33615-71-C-1754; AF Proj. 643A)
(AD-767300; GDCA-DHG73-001-Vol-6;
AFFDL-TR-73-21-Vol-6) Avail: NTIS CSCL 01/3

The air cushion landing system for the STOL transport aircraft is discussed. The configuration includes a rubber-nylon, torus-shaped trunk attached to the lower portion of the fuselage. Air is supplied to the trunk by turboshaft-driven fans. It is then exhausted through rows of holes along the trunk ground tangent. Aircraft weight is distributed over the cushion area providing the desired low ground pressure. After liftoff, the trunk is deflated and retracts into the fuselage by elastic action. Author

N74-13737# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMAL CAPABILITIES OF HYPERSONIC PASSENGER AIRCRAFT ON KEROSENE FUEL
Ya. N. Gaukham 12 Sep. 1973 25 p Transl. into ENGLISH from Sb. Aerodin. Sverkhzvukovykh Samoletov (USSR), v. 2, no. 182, 1971 p 14-30
(AD-767887; FTD-HT-23-801-73) Avail: NTIS CSCL 01/3

The report evaluates the optimum flight characteristics of a hypersonic aircraft using kerosene fuel. GRA

N74-13738# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLIGHT CONTROL OF AIRPLANES AND HELICOPTERS
V. T. Borodin and G. I. Rylskii 27 Sep. 1973 342 p refs Transl. into ENGLISH of the publ. "Upravlenie Poletom Samoletov i Vertoletov" Moscow, 1972 p 1-238
(AD-767943; FTD-MT-24-318-73) Avail: NTIS CSCL 01/3

In the report an analysis is given and fundamental results systematized from foreign investigations on the development of promising means of automation of flight control of aircraft and helicopters. Structural diagrams and descriptions of the control systems of contemporary aircraft and helicopters, flexible aircraft, and also adaptive (self-adjusting, with variable structure, self-organizing) aviation systems are given. Bionic principles of adaptation and the possibility of their use in control systems of aircraft, and also the problems of automation of landing, flight on low and maximally low altitudes, and the arrangement of installed equipment are examined. Methods of reflecting flight information to the pilot, the systems of semiautomatic control, systems for the prevention of collisions of aircraft in the air, landing systems, profile flight and the contemporary complexes of installed equipment are described. GRA

N74-13739# Naval Postgraduate School, Monterey, Calif.
A MODIFIED DESIGN CONCEPT, UTILIZING DECK MOTION PREDICTION, FOR THE A-7E AUTOMATIC CARRIER LANDING SYSTEM M.S. Thesis
Thomas Maxwell Judd Jun. 1973 75 p refs
(AD-767691) Avail: NTIS CSCL 01/2

The present concept of automatic carrier landings, Mode I operational capability, as employed in Navy carrier-based aircraft, was investigated. The aircraft chosen for study was the A-7E. The A-7E All Weather Carrier Landing System (AWCLS) and the carrier landing environment including burble effects and deck motion were simulated. Height of hook above ramp, touchdown point, and velocity of impact dispersions were determined. The current system was then modified, utilizing the concept of a SPN-42 Deck Motion Compensation Lead Computer which operates on the basis of known aircraft characteristics and predicted carrier heave motion. Simulation showed that automatic carrier landing performance as measured by number of ramp strikes, hard landings, and bolters could be improved. The modifications suggested require only a minimum of component additions to the AWCLS currently in use in the Navy. Author (GRA)

N74-13740# Army Material Command, Texarkana, Tex. Intern Training Center.
MINIMUM LIFE CYCLE COSTING FOR A V/STOL TRANSPORT
Thomas W. Smith 1973 120 p refs
(AD-768133; USAMC-ITC-1-73-21) Avail: NTIS CSCL 01/3

The report proposes a new methodology for life cycle costing. In particular, a Vertical/Short Take-off and Landing (V/STOL) transport aircraft is considered. The costs included are those of research and development, production, maintenance, and

operation. The minimum cost is found by the minimization of a function of three variables; maximum speed at best altitude, gross take-off weight, and maximum thrust per engine. Several methods of minimization were investigated, including geometric programming, Sequential Unconstrained Minimization Technique (SUMT), and the pattern search technique. The latter method was used with success and numerous computer runs were executed. The impact of the variation of many input parameters is shown in the results. Author (GRA)

N74-13741# Sanders Nuclear Corp., Nashua, N.H.
TACTILE DISPLAY FOR AIRCRAFT CONTROL Final Technical Report, 1 Jul. 1972 - 31 Aug. 1973
Don H. Ross, Richard A. Sanneman, William H. Levison, Robert B. Tanner, and Thomas J. Triggs 31 Aug. 1973 97 p refs Prepared in cooperation with Bolt, Beranek and Newman, Inc., Cambridge, Mass.
(Contract N00014-73-C-0031; ARPA Order 2108; NR Proj. 196-123)
(AD-767763) Avail: NTIS CSCL 01/4

The final report presents a set of manual tracking experiments that have been conducted to determine the suitability of tactual displays for presenting flight-control information in multi-task situations. Although tracking error scores are considerably greater than scores obtained with a continuous visual display, preliminary results indicate the inter-task interference effects are substantially less with the tactual display in situations that impose high visual scanning workloads. The single-task performance degradation found with the tactual display appears to be a result of the coding scheme rather than the use of the tactual sensory mode per se. Analysis with the state-variable pilot/vehicle model shows that reliable predictions of tracking errors can be obtained for a limited set of system configurations once the pilot-related model parameters have been adjusted to reflect the pilot-display interaction. Author (GRA)

N74-13742# Naval Aerospace Medical Research Lab., Pensacola, Fla.
ORIENTATION-ERROR ACCIDENTS IN REGULAR ARMY UH-1 AIRCRAFT DURING FISCAL YEAR 1970: RELATIVE INCIDENCE AND COST
Jorma I. Niven, W. Carroll Hixson, and Emil Spezia 14 Sep. 1973 36 p refs
(MF51524005)
(AD-768307; NAMRL-1192; USAARL-74-5) Avail: NTIS CSCL 01/2

The report is the fourth in a series of reports dealing with pilot disorientation/vertigo accident problem is Regular Army UH-1 helicopter operations. Incidence and cost data presented for fiscal year 1970 include a total of 43 major and minor orientation-error, accidents (17 of which were fatal), resulting in 66 fatalities, 67 nonfatal injuries, and a total UH-1 aircraft damage cost of $7,706,191. Author (GRA)

N74-13743# Army Natick Labs., Mass. Clothing and Personal Life Support Equipment Lab.
ENGINEERING EVALUATION OF AGE LIFE EXTENSION, T-10 HARNESSES, RISERS AND T-10 TROOP CHEST RESERVE PARACHUTE CANOPIES. SUPPLEMENT 1: 1964 - 1965 YEAR CLASSES
Michael E. Mahar, Vasant K. Devarakonda, and Richard D. Wells Oct. 1973 23 p
(AD-767711; C/PLSEL-112-Suppl-1; USA-NLABS-TR-74-9-CE-Suppl-1) Avail: NTIS CSCL 01/3

An engineering evaluation of T-10 troop-type harnesses, risers, and chest reserve parachute assemblies of year classes (dates of manufacture) 1964 and 1965 was conducted by laboratory testing of component materials. The data obtained from limited samplings from Fort Bragg, No. Carolina, Alaska and the Panama Canal Zone indicated a generally serviceable condition for this equipment at nine and eight years of total age. Taken with more extensive data and with the technical background and criteria developed in the earlier basic report 72-59-CE, (DDC AD 742-668) of the same title, dated March 1972, it was concluded that the recently extended 13 year (risers and harnesses) and 12 year (canopy assemblies) limits are fully substantiated for these 1964-65 classes. Subject to later check testing, further extension of the age life limit may be found appropriate. Author (GRA)

N74-13744# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A PRELIMINARY DESIGN OF A REMOTELY-CONTROLLED GLIDER FOR A LONG-LINE OPERATION M.S. Thesis
Elbridge Lee Snapp, III Jun. 1973 106 p refs
(AD-767879; GA/AE/71-1) Avail: NTIS CSCL 01/3

Low-level, covert observation of a small area of ground may be obtained by an unmanned glider towed from a large aircraft and suspended in Long-Line-Loiter. This glider is equipped with a Visually-Coupled Control System operated through a Low-Light-Level Television camera. The glider has a gross weight of 442.5 lb of which 282.3 lb is payload. The vehicle features a high wing and a constant-chord airfoil with 30 ft span. Overall vehicle length is 17.7 ft. Wings-level stall speed is 35.8 knots. The glider exhibits static longitudinal, lateral, and directional stability. Attaching the tow cable to the top of the fuselage above the vehicle center of gravity allows the glider to be flown in high-speed trail or suspended in Long-Line-Loiter. Author (GRA)

N74-13745# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
PRODUCTION DATA PACKAGE 267 GALLON EXTERNAL FUEL TANK
Albert E. Simkins 23 Aug. 1973 28 p refs
(AD-767937; NADC-73147-30) Avail: NTIS CSCL 01/3

A production data package was developed for a 267 gallon external fuel tank suitable for use on the F-14 aircraft. Author (GRA)

N74-13746# Illinois Univ., Savoy. Aviation Research Lab.
THE DESIGN AND FLIGHT EVALUATION OF A PERFORMANCE CONTROL SYSTEM M.S. Thesis
Craig Alan Bergman Aug. 1973 68 p refs
(Contract F44620-70-C-0105; AF Proj. 9778)
(AD-767786; ARL-73-16/AFOSR-73-10; AFOSR-73-1696TR) Avail: NTIS CSCL 01/3

A performance control system, which provides direct pilot control of vertical speed and bank angle, has been designed and flight tested in a twin-engine, general aviation aircraft. Automatic coordination and lift compensation in turns are provided. The system is FAA-certified for normal category operations under VFR conditions, above 400 feet AGL, with a qualified safety pilot. The operating ranges are plus or minus 1500 fpm vertical speed and plus or minus 60 degrees of bank angle. The system is insensitive to airspeed and altitude changes. Vertical speed accuracy is within 100 fpm for changes of power setting and landing gear extension/retraction. During flap changes and turning maneuvers the vertical speed changes by as much as 550 fpm, but recovery to within 100 fpm is accomplished within 20 seconds. Bank angle holding accuracy is approximately three degrees for turns of standard rate or less. Author (GRA)

N74-13747# Naval Postgraduate School, Monterey, Calif.
THE SIMULATION AND ANALYSIS OF CARRIER LANDINGS USING A NONLINEAR PILOT MODEL M.S. Thesis
Clark Albert Wilson Jun. 1973 62 p refs
(AD-767679) Avail: NTIS CSCL 01/2

The report investigated the interaction of the pilot and the Fresnel lens optical landing system (FLOLS) with the aircraft system dynamics of a carrier landing and attempted to determine whether or not the dynamics of the FLOLS contributed to a nosedown command by the pilot when approaching touchdown. With the assumption of a nonlinear pilot model, the entire system's equations of motion were programmed on an analog computer and time histories of approaches for various pilot gains were recorded and analyzed. Results obtained showed that the stability of the entire system near touchdown was very sensitive to gains which the pilot adopted. Also, because of the lag in the FLOLS dynamics, the pilot would, for some pilot gains, input a definite nosedown command to counteract a rising meatball on the FLOLS display. The typical result of such a command is a hard landing or ramp strike. Author (GRA)

N74-13748# Naval Postgraduate School, Monterey, Calif.
THE DESIGN, FABRICATION AND EVALUATION OF THE AURAL ANGLE OF ATTACK/STALL WARNING SYSTEM
Penn Evans Mullowney, Jr. Jun. 1973 90 p refs

(AD-767663) Avail: NTIS CSCL 01/2

Maximum performance and stall avoidance can be realized in high-performance aircraft only if the pilot is fully aware of angle of attack. Because present methods of providing this information have proven to be inadequate, an alternative method has been proposed. The paper describes an electronic device providing angle of attack. GRA

N74-13749# Air Force Academy, Colo. Dept. of Aeronautics.
A PYLON TO DECREASE THE EFFECTS OF EXTERNAL STORES ON THE STABILITY OF AIRCRAFT Final Report
Edgar W. Lorson and Lawrence E. Day Jul. 1973 51 p refs
(AD-767913; DFAN-TR-73-5) Avail: NTIS CSCL 01/3

A series of wind tunnel studies were accomplished at the USAFA to determine the effect of a new low side area pylon on the static longitudinal stability of aircraft carrying external stores. Several configurations of MK 82 and M 117 bombs on triple ejection racks and multiple ejection racks were run at Mach numbers of .2, .82 and .91. The static margins for similar bomb configurations on inventory type pylons and new low side area pylons are compared. For the tests at M .2 the loss in static margin for a given configuration on the new low side area pylon was an average of 19% less than that on an inventory type pylon. The average loss in static margin for the transonic runs with the inventory pylon was 8.9% mean aerodynamic chord (MAC) while the same configurations with the new pylon gained an average of 2.2% mean aerodynamic chord (MAC).
Author (GRA)

N74-13750# Air Force Academy, Colo. Dept. of Aeronautics.
A COMPUTER PROGRAM FOR AIRCRAFT OPTIMAL CONTROL PROBLEMS
Jerry D. Hines and Juane M. Davis Jul. 1973 117 p refs
(AD-767919; DFAN-TR-73-4) Avail: NTIS CSCL 01/3

The report described uses a gradient technique having a rapid convergence rate to investigate problems of aircraft optimal control. The FORTRAN program for the Burroughs 6700 computer and sample output are included for a minimum time turn (3 dimensional) for an aircraft with thrust vectoring capability. The operation of the program is explained and the program variables are identified. Author (GRA)

N74-13751# Center for Naval Analyses, Arlington, Va.
AIRCRAFT FORCE PROTECTION MODEL. VOLUME 1: USERS GUIDE TO AFPM
Steven W. Klein and Thomas H. Thoureen Mar. 1973 151 p refs
(Contract N00014-68-A-0091)
(AD-767946; CNA-Res-Contrib-225) Avail: NTIS CSCL 15/5

The Aircraft Force Projection Model (AFPM) is a FORTRAN. model which projects the Navy's aircraft inventory over a ten-year period and attempts to satisfy the operating requirements of a given set of forces with the projected operating inventory. This comparison of operating inventory and force requirements is the characteristic which sets the AFPM apart from most inventory projection models. The AFPM generates useful characteristics of the aircraft inventory such as projections of the age distribution, attrition quantities, pipeline requirements and rework requirements. Author (GRA)

N74-13752# Environmental Protection Agency, Washington, D.C. Office of Noise Ablatement and Control.
MILITARY AIRCRAFT AND AIRPORT NOISE AND OPPORTUNITIES FOR REDUCTION WITHOUT INHIBITION OF MILITARY MISSIONS Final Report
Sidney Nethery 27 Jul. 1973 187 p refs
(PB-223637/0GA) Avail: NTIS HC $5.25 CSCL 01C

The report is a result of an extensive task force effort to gather all available data pertinent to military aircraft and airport noise and opportunities for reduction without inhibition of military missions. It represents the interpretation of such data by the task group chairman responsible for this specific report. GRA

N74-13753# Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.
TURNING CHARACTERISTICS OF THE BELL 100 TON SURFACE EFFECT SHIP M.S. Thesis
Kenneth Randall Myers Jun. 1973 145 p refs
(AD-767680) Avail: NTIS CSCL 13/10

The turning characteristics of the Bell 100 ton captured Air Bubble Surface Effect Ship (CAB/SES) are studied with the aid of the Oceanic Incorporated computer simulation. The crafts motions for straight runs, straight runs with waves and turning runs under calm water conditions, are compared with the final set of computer simulation turning maneuvers with waves involving changing speeds, wavelengths, wave amplitudes, and final rudder angles. Author (GRA)

N74-13754# Rockwell International Corp., Los Angeles Calif. Aircraft Div.
STOL TACTICAL AIRCRAFT INVESTIGATION, EXTERNALLY BLOWN FLAP. VOLUME 1: CONFIGURATION DEFINITION. SUPPLEMENT 1: AERODYNAMIC TRADES OF FLAP AND ROLL CONTROL SYSTEM Final Report, 10 Jun. 1971 - 10 Dec. 1972
Dirk J. Renselaer Wright-Patterson AFB, Ohio AFFDL Apr. 1973 122 p refs 6 Vol.
(Contract F33615-71-C-1760; AF Proj. 643A)
(AD-767179; AFFDL-TR-73-20-Vol-1-Suppl-1) Avail: NTIS CSCL 01/3

Contents: Comparison of climb speeds; Comparison of roll acceleration with all engines operating; Comparison of roll acceleration with one engine inoperative; Comparison of lift loss due to maximum roll control. GRA

N74-13755# Rockwell International Corp., Los Angeles Calif. Aircraft Div.
STOL TACTICAL AIRCRAFT INVESTIGATION, EXTERNALLY BLOWN FLAP. VOLUME 3: PERFORMANCE METHODS AND LANDING RULES Final Report, 10 Jun. 1971 - 10 Dec. 1972
Dirk J. Renselaer Wright-Patterson AFB, Ohio AFFDL Apr. 1973 161 p refs 6 Vol.
(Contract F33615-71-C-1760; AF Proj. 643A)
(AD-767180; AFFDL-TR-73-20-Vol-3) Avail: NTIS CSCL 01/3

Contents: Identification of critical STOL safety aspects; Recommended ground rules; STOL takeoff performance; STOL landing performance. GRA

N74-13756# Rockwell International Corp., Los Angeles Calif. Aircraft Div.
STOL TACTICAL AIRCRAFT INVESTIGATION, EXTERNALLY BLOWN FLAP. VOLUME 5, PART 1: CONTROL SYSTEM MECHANIZATION TRADE STUDIES Final Report, 10 Jun. 1971 - 10 Dec. 1972
Robert W. Phillips Wright-Patterson AFB, Ohio AFFDL Apr. 1973 70 p refs 6 Vol.
(Contract F33615-71-C-1760; AF Proj. 643A)
(AD-767181; AFFDL-TR-73-20-Vol-5-Pt-1) Avail: NTIS CSCL 01/3

Contents: System analyses; System characteristics comparison; Control component requirements; Handling qualities. GRA

N74-13757# Rockwell International Corp., Los Angeles Calif. Aircraft Div.
STOL TACTICAL AIRCRAFT INVESTIGATION, EXTERNALLY BLOWN FLAP, VOLUME 5, PART 3: STABILITY AND CONTROL DERIVATIVE ACCURACY REQUIREMENTS AND EFFECTS OF AUGMENTATION SYSTEM DESIGN Final Report, 10 Jun. 1971 - 10 Dec. 1972
Victor H. Kumoto and William K. Elsanker Wright-Patterson AFB, Ohio AFFDL Apr. 1973 201 p refs 6 Vol.
(Contract F33615-71-C-1760; AF Proj. 643A)
(AD-767182; AFFDL-TR-73-20-Vol-5-Pt-3) Avail: NTIS CSCL 01/3

Contents: Flying qualities requirements; Selection of baseline flight condition; Selection of coefficient variation ranges; Technical approach; Coefficient prediction accuracy requirements; Lateral-directional parameter variation data; Longitudinal parameter variation data; Coefficient accuracy requirements -- unaugmented aircraft; Coefficient accuracy requirements -- baseline augmented aircraft. GRA

N74-14675 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).

AEROTECHNOLOGY IN AVIATION PROBLEMS [LUFTFAHRTTECHNISCHER BEREICH]
In its DFVLR Annual Review, 1972 1972 p 383-401 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

N74-14288 Direction Technique Avions, Paris (France). Aerospatiale.
MEASURE OF MINOR CONSTITUENTS IN THE STRATOSPHERE BY CONCORDE 001 [MESURES DES CONSTITUANTS MINEURS DANS LA STRATOSPHERE PAR CONCORDE 001]
R. Joatton *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 7 p refs In FRENCH (For availability see N74-14271 05-20)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines, hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; Nuclear Engineering; and 28 Propulsion Systems.

N74-13758 California Univ., Los Angeles.
MODELING, IDENTIFICATION AND CONTROL OPTIMIZATION OF A SATELLITE POWER SYSTEM Ph.D. Thesis
Antoni Raffaele Durando 1973 134 p
Avail: Univ. Microfilms Order No. 73-23386

A mathematical model for a satellite solar array-battery power system was developed. The model is used to optimize the thermodynamic performance of the battery as a function of the charge control. The model stresses the characteristics of the charge-discharge process and the coupling between the electrical and chemical phenomena. The areas of research consisted of: (1) development of systems equations, (2) parameter identification, and (3) solving for the charging terminal voltage which minimized the temperature fluctuations of the system. Dissert. Abstr.

N74-13759 Polytechnic Inst. of Brooklyn, N.Y.
THE SYNCHRONOUS EFD DEVICE Ph.D. Thesis
Frank Richard Honigsbaum 1973 110 p
Avail: Univ. Microfilms Order No. 73-24769

A survey of the literature reveals that the major objection to the use of electrofluiddynamic devices for direct energy conversion has been that of low output per stage. This objection does not apply to the synchronous EFD device, because it permits simple and effective multistaging. Since the synchronous EFD Device is a recent development, efforts were directed toward: (1) describing the basic concept; (2) validating it experimentally; (3) assaying its potential; and (4) deriving a simple circuit model. All of these objectives were met. Dissert. Abstr.

N74-13760# Technische Universitaet, Brunswick (West Germany).
VOLTAGE REGULATION IN FUEL CELL AGGREGATES BY ELECTROCHEMICAL CONTROL ELEMENTS Ph.D. Thesis [SPANNUNGSBEE INFLUSSUNG VON BRENNSTOFFZELLEN-AGGREGATEN DURCH ELEKTROCHEMISCHE STELLGLIEDER]
Frank Ermisch 1973 165 p refs In GERMAN
Avail: NTIS HC $10.25

Load adjustment in a fuel cell is achieved by directing the energy flux with a parallel diode through the cell, thus cutting off the oxygen supply to the electrodes. Limitations on voltage modulation are imposed by parallel wiring in an electrolytic cell or use of an accumulator cell. Transl. by G.G.

N74-13761*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation and Engineering Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: INITIAL EVALUATION TESTS OF GULTON INDUSTRIES, INCORPORATED, 20.0 AMPERE-HOUR NICKEL-CADMIUM SPACECRAFT CELLS WITH AUXILIARY ELECTRODES
J. D. Harkness 4 Jan. 1974 23 p
(NASA Order S-23404-G)
(NASA-CR-136318; QEEL/C-74-2) Avail: NTIS HC $3.25 CSCL 10A

The results of the test program for selecting aerospace cells are evaluated. The cells were tested for capacity, voltage, leakage, internal resistance, and charge efficiency. Test data are tabulated. F.O.S.

N74-13762*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation and Engineering Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: SYNCHRONOUS ORBIT TESTING OF GENERAL ELECTRIC COMPANY 6.0 AMPERE-HOUR SEALED NICKEL-CADMIUM CELLS
D. E. Christy 15 Oct. 1973 47 p
(Contract NASA Order S-23404-G)
(NASA-CR-136317; QEEL/C-73-302) Avail: NTIS HC $4.50 CSCL 10C

The performance of sealed nickel cadmium cells operating under a synchronous orbit regime is analyzed. Results show that: (1) A temperature of 40 C is very detrimental to cells as may be noted from the low capacities for the 40 C pack; (2) a temperature of -20 C results in high cell voltages during charge. (3) Coulometers are effective charge control devices when operative. However, they have shorter lives than the cells they control; (4) the voltage balance, during discharge, between the high and low cells of a synchronous pack is best at 25 C and worst at 40 C. Also, age and greater depths of discharge result in greater degradation of pack voltage balance; and (5) all packs, except 5 and 6 which are coulometer controlled, show a tendency to be reconditioned by the capacity check at the middle of each eclipse. Author

N74-13763*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation and Engineering Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. INITIAL EVALUATION TESTS OF EAGLE-PICHER INDUSTRIES, INCORPORATED 3.0 AMPERE-HOUR NICKEL-CADMIUM SPACECRAFT CELLS
J. D. Harkness 29 Oct. 1973 23 p refs
(NASA Order S-23404-G)
(NASA-CR-136253; QEEL/C-73-380) Avail: NTIS HC $3.25 CSCL 10A

The capacity of the cells ranged from 3.58 to 3.97 ampere-hours during the three capacity tests. Three cells were removed from test, due to high pressure, during the C/10, 24-hour charge at room ambient temperature. The voltage requirement of 1.480 volts was exceeded by the cells during the C/10, 24-hour charge at 20 C, although the end-of-charge voltage was below this value (1.466-1.475 volts). Average capacity out during the 20 C charge efficiency test was 0.84 AH which represents 48% and is below the minimum requirement of 55%. The cells exhibited no pressure decay during the open-circuit stand portion of the pressure versus capacity test, as all cells reached their voltage limit (1.550 volts) before their pressure reached 20 psia with the highest pressure being 8 psia during charge. Author

N74-13764*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN EXPERIMENTAL EVALUATION OF METALLIC DIAPHRAGMS FOR POSITIVE FUEL EXPULSION IN THE ATMOSPHERE EXPLORER HYDRAZINE PROPULSION SUBSYSTEM
William L. Woodruff Washington Dec. 1973 13 p ref Presented at the Monopropellant Propulsion Specialist Session of the JANNAF Propulsion meeting, 28 Nov. 1972, New Orleans
(NASA-TN-D-7467; G-7355) Avail: NTIS HC $2.75 CSCL 21H

Four Arde conospheroid metallic diaphragms were tested to evaluate their capability for use in the orbit adjust propulsion subsystem (OAPS) of the Explorer spacecraft. The diaphragms will be used for positive propellant expulsion and spacecraft center of mass control. A leak-free cycle life capability of nine reversals was demonstrated. The diaphragms rolled smoothly from ring to ring in a predictable manner on the first reversal. Varying amounts of diaphragm cocking and ring skipping were observed on subsequent reversals. The diaphragm pressure differential did not exceed 7 N/sq cm during any reversal. Cycle life capability,

reversal mode, and pressure differential were not affected by sudden reversals, environmental tests, or 18,000 partial reversals. An expulsion efficiency of approximately 97 percent was demonstrated. The results of these tests show that metallic diaphragms can be used as an effective means of positive fuel expulsion; however, to achieve spacecraft center of mass control, the diaphragm must not be reversed prior to flight.
Author

N74-13765# Bendix Corp., Kansas City, Mo.
ULTRASONIC WELDING OF NYLON CELL CASES ON A NICKEL-CADMIUM BATTERY
G. W. Bengtson Aug. 1973 21 p refs
(Contract AT(29-1)-613)
(BDX-613-888-Rev) Avail: NTIS HC $3.25

A joint design and ultrasonic welding schedule capable of making a leak-tight pressure joint in nylon was developed. This will permit the replacement of polystyrene with nylon for cell cases on a nickel-cadmium battery. Author (NSA)

N74-13766# Energy Research Corp., Bethel, Conn.
HYDROGEN GENERATOR Final Technical Report
Edward S. Tillman, Jr. Aug. 1973 66 p refs
(Contract DAAK02-71-C-0397; DA Proj. 1G6-63702-DG-10)
(AD-767402; ERC-0397F) Avail: NTIS CSCL 10/2

A compact hydrogen generator for small liquid hydrocarbon fueled fuel cells was designed, built and partially tested. The basic generator embodies the steam reforming of liquid fuels available to the military. Provisions have been made for sulfur removal and hydrogen purification can be achieved with a palladium-silver hydrogen separator. Extensive testing on the reforming unit was conducted and results reported. An electronic control system for startup and steady state operation was designed and built but was not fully integrated with the reformer. Emphasis throughout the study was placed on miniaturizing components. Author (GRA)

N74-13767# Sundstrand Corp., Rockford, Ill.
DEVELOPMENT OF A LIGHTWEIGHT HYDRAULIC STARTER SYSTEM FOR AN AIRBORNE AUXILIARY POWER UNIT Final Report, 14 Jun. 1971 - 30 Apr. 1973
Stephen C. Paskevich, Walter J. Iseman, and Richard W. Reynolds Aug. 1973 614 p refs
(Contract F33615-71-C-1695; AF Proj. 3145)
(AD-768200; AFAPL-TR-73-65) Avail: NTIS CSCL 21/5

A report is made of the design study, fabrication and testing of an advanced high pressure hydraulic starting system suitable for use on a high powered lightweight auxiliary power unit (ADP). The purpose of the study was to develop the smallest lightest possible hydraulic starting system for a 400 HP APU being developed under Air Force Contract F33615-69-C-1100. Key development items were: (1) an 8000 psi helium pressurized metal bellows accumulator using a high strength steel shell with carbon fiber Epoxy composite overwrap; (2) an 8000 psi hydraulic motor and hydraulic intensifier unit utilizing only one hydraulic unit; and (3) a hydraulic flow sensing starter cutout valve requiring no electrical inputs. The report describes the design rationale in selecting parameters and specific hardware to build an operating system as well as actual test results. Author (GRA)

N74-13768# Army Material Command, Texarkana, Tex. Intern Training Center.
DETERMINATION OF THE NUMBER OF HYDROCARBON-AIR FUEL CELLS AND MAINTENANCE PERSONNEL REQUIRED BY A MISSION
Thomas H. Proeschel May 1973 123 p
(AD-768130; USAMC-ITC-1-73-16) Avail: NTIS CSCL 10/2

The report explores these questions: (1) how many hydrocarbon-air fuel cell power plants should be used in a standby configuration to insure continuous power for a small, field type communications facility, and (2) how many repair personnel will be required to maintain the power plants for a number of these communication facilities. A GASP II events simulation model is developed that combines environmental and power plant design information to answer the above deployment and personnel questions. Results of the study indicate that for the environment and tactical situation investigated, only two fuel cell power plants in standby configuration would insure the same or better facility power reliability as that would be obtained by using three gasoline engine generators in standby configuration. Also there would be a substantial reduction in the number of repairmen that would be required if fuel cell plants were used instead of gasoline generators. Author (GRA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N74-13769*+ National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 120, OCTOBER 1973
Oct. 1973 101 p refs
(NASA-SP-7011(120)) Avail: NTIS HC $4.25 CSCL 06E

This special bibliography lists 354 reports, articles, and other documents introduced into the NASA scientific and technical information system in September 1973. Author

N74-13770# Translation Consultants, Ltd., Arlington, Va.
STUDIES OF SMOKE DAMAGE TO TREES. 1: ACUTE SO2 DAMAGE SYMPTOMS
Y. Nakashima, Y. Hagiura, S. Ogawa, and T. Kawashima [1973] 53 p refs Transl. into ENGLISH from Fukuoka Ken Kenkyujo jiho 21 Go (Japan), no. 21, 1970 p 23-50 Sponsored by EPA
(TR-389-73) Avail: NTIS HC $4.75

Acute SO2 damage symptoms in the principal forestation tree varieties are reported. 35 varieties were exposed to SO2 (0.1 ppm - 12 ppm) and surveys were made of damage symptoms and the subsequent growth state. Seedlings of the principal forestation trees (1-2 years) demonstrated considerable damage symptoms following exposure to 10 ppm of SO2 for 30 minutes. Of the four principal production species, Cryptomeria japonica and Pinus densiflora had least resistance to acute SO2 damage, Pinus thunbergii was the next strongest, while Chamaecyparis obtusa was the strongest. Acute SO2 damage symptoms varied with the type of tree and a number of systematic classifications for this damage are considered. Author

N74-13771# Joint Publications Research Service, Arlington, Va.
MAGNESTISM IN BIOLOGY
Yu. A. Kholodov 10 Dec. 1973 91 p refs Transl. into ENGLISH of the book "Magnetizm v Biologii" Moscow, Nauka, 1970 97 p
(JPRS-60737) Avail: NTIS HC $6.75

A study was made of magnetiobiology, specifically the effects of magnetic fields on biological entities were analyzed. Data are included on the history, current research, and future prospects for magnetobiology. Author

N74-13772*# Scientific Translation Service, Santa Barbara, Calif.
CLINICAL ASPECTS OF DRUG-INDUCED DISEASES OF THE LIVER
G. A. Martin Washington NASA Jan. 1974 15 p Transl. into ENGLISH from Z. fuer Gastroenterologie (West Ger.), v. 11, no. 5, 1973 p 343-350
(Contract NASw-2483)
(NASA-TT-F-15235) Avail: NTIS HC $3.00 CSCL 06E

Drug induced liver damage, examples of the different types of damage, and the medicines that cause such damage are reviewed. Author

N74-13773*# Techtran Corp., Glen Burnie, Md.
MORPHOLOGICAL CHANGES IN MUSCLES AND NERVES OF THE EXTREMITIES UNDER CONDITIONS OF OVER-TRAINING
P. Z. Gudz Washington NASA Jan. 1974 14 p refs Transl. into ENGLISH from Ark. Anat., Gistol. Embriol. (USSR), v. 45, no. 7, 1963 p 55-63

(Contract NASw-2485)
(NASA-TT-F-15251) Avail: NTIS HC $3.00 CSCL 06P

Models of trained and overtrained organisms were created in experiments on animals (dogs, goats and rats). A histological study revealed progressive changes in the muscles of animals subjected to moderate and submaximal loads. These changes reflect an adaptation of the organism to physical loads. Destructive and dystrophic alterations of part of muscle fibers were found in extermital muscles of the animals additionally subjected to the regime of prolonged maximum loads which produced a state of chronic fatigue. Trained motor nerve endings became considerably dilated and contained a large number of terminals and nuclei of Schwann's glia. Chronically fatigued motor nerve endings became distinctly reduced, as if compressed into a ball. Nuclei of Schwann's glia decrease number, parts of them were well impregnated. Author

N74-13774*# Kanner (Leo) Associates, Redwood City, Calif.
SENSITIZATION TO METABOLIC AND CARDIOVASCULAR EFFECTS OF CATECHOLAMINES
J. LeBlanc, J. Valliere, and C. Vachon Washington NASA Dec. 1973 4 p Transl. into ENGLISH from J. Physiol. (Paris), v. 65 (Suppl.), Oct. 1972 p 255 A
(Contract NASw-2481)
(NASA-TT-F-15220) Avail: NTIS HC $3.00 CSCL 06E

The mechanisms of sensitization to the cardiovascular and metabolic effects of catecholamine are studied. It is found that guanethidine increases the tensor response to noradrenaline by blocking its uptake, rather than by increasing the sensitivity of the alpha receptors. It is demonstrated that repeated injections of noradrenaline have no effect on the activity of the alpha receptors in response to a given stimulus. On the other hand, the sensitization of the beta receptors seems to be effected by other mechanisms: repeated injections of isoproterenol sharply increase the response to it: there is a 70% increase in oxygen, cardiac rhythm is elevated, and there is a strong increase in the contractile force of the-ventricle. Repeated injections of isoproterenol increase the sensitivity of the beta receptors, possibly by means of the cyclic AMP, while the sensitization of the alpha receptors would seem to be due simply to a diminution in uptake. Author

N74-13775*# Techtran Corp., Glen Burnie, Md.
PSYCHOPHYSIOLOGY: RELATIONSHIPS IN RATS BETWEEN SPEED OF LEARNING AND DURATION OF PARADOXICAL SLEEP DURING THE NYCTHEMERIC CYCLE
Jean Delacour, Odile Houcine, and Jean Brenot Washington NASA Dec. 1973 7 p refs Transl. into ENGLISH from Compt. Rend. (France), ser. d, v. 275, 6 Dec. 1972 p 2725-2728
(Contract NASw-2485)
(NASA-TT-F-15222) Avail: NTIS HC $3.00 CSCL 06C

The relationships between paradoxical sleep and avoidance learning in rats were studied according to a procedure reducing the direct interactions between these two variables. The findings suggested the existence of a relationship between the speed of this learning and the value of the duration of paradoxical sleep/waking period ratio during the nycthemeral cycle. Author

N74-13776*# Techtran Corp., Glen Burnie, Md.
THE EFFECT OF DIPINE ON PHENOBARBITAL INDUCTION OF CYTOCHROME P-450 INDUCTION AND STIMULATION OF MITOTIC ACTIVITY IN THE HEPATIC CELLS OF THE RAT
V. V. Klimenko, L. Ye. Nemirovskiy, and G. R. Mutovin Washington NASA Dec. 1973 6 p refs Transl. into ENGLISH from farmakol. i Toksikol. (Moscow), v. 36, no. 5, 1973 p 597-599
(Contract NASw-2485)
(NASA-TT-F-15225) Avail: NTIS HC $3.00 CSCL 06C

The influence exerted by dipline on the induction with phenobarbital of cytochrome P sub 450 and on the stimulation of the mitotic activity in the rat's liver was studied. Both of them are shown to be inhibited even in the case when the phenobarbital induction is instituted 60 days after a single injection of a non-cytostatic dose of the mutagen. It is believed that changes occurring in the genetic system of the cell produced by dipline lie at the root of the cited phenomena. Author

N74-13777*# Scientific Translation Service, Santa Barbara, Calif.
X-RAY KYMOGRAPHIC INVESTIGATIONS OF THE CENTRAL CIRCULATORY ORGANS IN THERAPEUTIC BATHS AND IN HYDROSTATIC PRESSURE ELEVATION. THEIR TECHNOLOGY, RESULTS AND POTENTIAL DEVELOPMENTS: A REVIEW
Friedrich Ekert Washington NASA Jan. 1974 36 p refs Transl. into ENGLISH from Arch. Physik. Therapie (Leipzig), v. 8, 1956 p 66-82
(Contract NASw-2483)
(NASA-TT-F-15227) Avail: NTIS HC $4.00 CSCL 06P

X-ray kymographic investigations in therapeutic baths are reviewed. Findings are summarized, and suggestions are made for future work on luman central circulatory organs. Author

N74-13778*# Scientific Translation Service, Santa Barbara, Calif.
EFFERENT INNERVATION OF THE VESTIBULE
Andre Gribenski Washington NASA Jan. 1974 21 p refs Transl. into ENGLISH from Ann. Oto-Laryngol. (Paris), V. 87, no. 1-2, 1970 p 77-92
(Contract NASw-2483)
(NASA-TT-F-15232) Avail: NTIS HC $3.25 CSCL 06P

From an extensive review of the recent literature, it is attempted to clarify the following relationships: afferent and efferent vestibular innervations, and nerve connections involving the cortical, subcortical and cerebellar activities and their influence on vestibular nuclei. Author

N74-13779*# Techtran Corp., Glen Burnie, Md.
PROBLEMS OF SPACE BIOLOGY, VOLUME 19: PROBLEMS OF THE RESISTANCE OF BIOLOGICAL SYSTEMS
B. N. Tarusov, ed. Washington NASA Nov. 1973 284 p refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii, Tom 19, Problemy Ustoychivosti Biologicheskikh Sistem" Moscow, Nauka Press, 1971 p 1-285
(Contract NASw-2485)
(NASA-TT-F-761) Avail: NTIS HC $6.50 CSCL 06C

The resistance of biological systems is discussed in connection with creating artificial life support systems for manned space flight. For individual titles, see N74-13780 through N74-13782.

N74-13780* Techtran Corp., Glen Burnie, Md.
THE LIMITS OF THE ADAPTATION OF LIFE TO EXTREME CONDITIONS (IN CONNECTION WITH PROBLEMS OF EXOBIOLOGY)
S. I. Aksenov *In its* Probl. of Space Biol., Vol. 19 (NASA-TT-F-761) Nov. 1973 p 1-76 refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii, Tom 19, Problemy Ustoychivosti Biologicheskikh Sistem" Moscow, Nauka Press, 1971 p 7-89 (For availability see N74-13779 05-04)
CSCL 06C

Accommodation is discussed as a universal evolutionary principle which essentially will apply to all life forms, regardless of chemical base (carbon, silicon, etc.). Life forms must either adapt to extreme conditions or perish, and for any life form an extremum factor is any significant deviation in environmental parameters. The possibility of life forms existing in specific extraterrestrial environments is discussed, and a conclusion is drawn which unequivocally states that through many forms of accommodation life is possible in many different environments. Author

N74-13781* Techtran Corp., Glen Burnie, Md.
MASS-ENERGY METABOLIC CHARACTERISTICS OF ALGAE
I. V. Smirnov *In its* Probl. of Space Biol., Vol. 19 (NASA-TT-F-761) Nov. 1973 p 77-171 refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii, Tom 19, Problemy Ustoychivosti Biologicheskikh Sistem" Moscow, Nauka Press, 1971 p 90-180 (For availability see N74-13779 05-04)
CSCL 06F

A mathematical analysis is given for the mass energy characteristics of photosynthesizing algae. An engineering-biological approach to this allows for a detailed analysis of the characteristics for a broad spectrum of environmental situations

in which such algae are used as a component of a life support system. Models of such systems are constructed and are employed to demonstrate actual and hypothetical situations. Computers are employed for this purpose. Author

N74-13782* Techtran Corp., Glen Burnie, Md.
KINETIC PRINCIPLES OF INTERACTION OF COMPONENTS IN COMPLEX BIOLOGICAL SYSTEMS
A. B. Rubin *In its* Probl. of Space Biol., Vol. 19 (NASA-TT-F-761) Nov. 1973 p 173-278 refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii, Tom 19, Problemy Ustoychivosti Biologicheskikh Sistem" Moscow, Nauka Press, 1971 p 181-285 (For availability see N74-13779 05-04)
CSCL 06F

A biomathematical analysis of component interaction in biological systems is given. Two primary types of systems are discussed - open systems and closed systems. The applicability of these systems to life support equipment in spacecraft is analyzed and formulae are provided to demonstrate the effect (theoretical) of closed and open systems in life support systems. Author

N74-13783*# Techtran Corp., Glen Burnie, Md.
THE EFFECT OF DEHYDRATION AND HYPERTHERMIA ON THE HOMEOSTASIS OF THE HEALTHY MAN
V. I. Pokrovskiy, V. V. Bulychev, T. Ye. Lisukova, V. V. Maleyev, V. A. Utekhin, T. Ye. Chernyayeva, Yu. M. Mayorov, S. S. Milovidova, and K. A. Kafarov Washington NASA Dec. 1973 11 p refs Transl. into ENGLISH from Sov. Med. (Moscow), no. 2, 1973 p 27-31
(Contract NASw-2485)
(NASA-TT-F-15250) Avail: NTIS HC $3.00 CSCL 06S

Clinico-physiological and biochemical changes of homeostasis in 16 healthy males undergoing dehydration of up to 3 to 4% of the body weight and in 8 normal males in whom the body temperature was raised to 38.1 to -40.3% were analyzed. Changes occurring in the physical and chemical properties of the blood, such as in its specific weight, viscosity, hematocrit (D.C.V.), protein, blood clotting system, acid-base balance, electrolytes and gas movement are described. Differences in the contractile activity and size of the heart, the state of the peripheral circulation following dehydration and hyperthermia and, in particular, the emergence of venous hyperoxemia in the last named cases were disclosed. Changes in the homeostasis following physiological dehydration were investigated with a view to giving substance to the method of water and electrolyte therapy used in treating dehydrated patients with acute gastrointestinal infections. Variations in hyperthermia are of interest in appraising the effect of therapy accorded to febrile infectious patients. Author

N74-13784# Advisory Group for Aerospace Research and Development, Paris (France).
PATHOPHYSIOLOGICAL CONDITIONS COMPATIBLE WITH FLYING
Heinz S. Fuchs, ed. (German Fed. Armed Forces, Bonn) Oct. 1973 152 p refs In ENGLISH and FRENCH Presented at AGARD Aerospace Med. Panel Specialist Meeting, Pensacola, Fla., 16-17 May 1973
(AGARD-CP-129) Avail: NTIS HC $9.75

Medical selection and maintenance procedures for aircrews are reported. The effects of ageing, flight stress, clinical and psychophysiological pathological factors on pilot flight fitness are considered. For individual titles, see N74-13785 through N74-13806.

N74-13785 German Federal Armed Forces, Bonn.
TECHNICAL EVALUATION REPORT, CONCLUSION AND RECOMMENDATIONS
Heinz S. Fuchs *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 10 p (For availability see N74-13784 05-04)

In the past, physical standards have been overly conservative, because it was necessary to base aeromedical criteria on medical concepts derived from experience with diseased states in hospital patients. Increasing experience with aircrew populations, based upon specific studies to disclose the relationships between the pathophysiology of early disease and the psychophysiological requirements of flight, allows a more subtilized interpretation of diagnostic and clinical findings and gives now a wider and safer prognostication. Therefore, it is believed that there is a justification to change these standards - based upon systematic and scientific reevaluation, taking advantage of newly developed knowledge and research techniques. Because of the unique nature of the ageing aircrew population, it is frequently necessary to accomplish this research directly upon the flyers themselves, rather than to extrapolate from general medical research. Author

N74-13786 Naval Aerospace Medical Research Lab., Pensacola, Fla.
THE THOUSAND AVIATORS: AGING AND THE BLOOD PRESSURE
Robert E. Mitchell *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 3 p (For availability see N74-13784 05-04)

Blood pressure patterns are discussed for the members of a research group over a 32 year period and the implications of the patterns. In contrast to what was previously thought to be the case, namely, that blood pressure levels not rise with increasing age, the latest survey indicates that there are many and important exceptions to this generality after 45 years of age. Since this is the period when most naval aviators enter the administrative phase of their careers, the finding has less significance than if it occurred at an earlier age but has greater operational significance in the case of commercial airline pilots inasmuch as these men continue to fly at age 60. It would appear that this late onset of increased blood pressure justifies the more liberal standards for admission to flight training. At the same time personnel in an active flight status can be allowed to continue active flying if no complications are noted and treatment is not indicated.
Author

N74-13787 Naval Aerospace Medical Research Lab., Pensacola, Fla.
ELEVATED BLOOD PRESSURE IN AIRCREW
D. R. Stoop, K. C. Stanton, and D. D. Brown *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 5 p (For availability see N74-13784 05-04)

The evaluation, management, and disposition of the aircrew with elevated blood pressure are frequently difficult problems. Analysis of evaluations reveals an obvious reluctance on the part of the physician to establish a diagnosis of hypertension and a tendency to avoid drug therapy in spite of accepted evidence that early treatment reduces morbidity. The implications and potential problems in this approach have been discussed, and current practices and policies regarding the aircrew with hypertension have been presented and defended. Author

N74-13788 School of Aerospace Medicine, Brooks AFB, Tex. Internal Medicine Branch.
RETURNING AIRMEN WITH ABNORMAL EXERCISE TESTS AND NORMAL CORONARY ANGIOGRAMS TO FLYING STATUS
Victor F. Froelicher, Frank G. Yanowitz, A. J. Thompson, and Malcolm C. Lancaster *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 7 p refs (For availability see N74-13784 05-04)

Individuals with ST segment changes during and/or after exercise are considered to have an increased risk of developing the manifestations of CAD (Coronary Artery Disease). However, it is also known that both the double Master's test and maximal treadmill testing yield false positive and negative results reactive to CAD. The results of coronary angiography are presented in 63 asymptomatic aircrewmen with resting repolarization abnormalities and exercise testing responses suggestive of coronary artery disease. Fifty-four per cent had angiographic coronary artery disease, and many had high risk lesions. Forty-six per cent had no angiographic lesions and were recommended for return to flying duties. The findings in this study, the lack of significant complications, the concern for public safety, and the economics of maintaining a flying force justify the continued use of elective coronary angiography in selected asymptomatic aircrewmen.
Author

N74-13789 School of Aerospace Medicine, Brooks AFB, Tex. Applied Physiology Branch.
MYOCARDIAL AND CEREBRAL FUNCTION DURING EXPOSURE TO CARBON MONOXIDE

Howard H. Erickson and Milton J. Hernandez-Perez *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 6 p refs (For availability see N74-13784 05-04)

Aircrew members exposed to carbon monoxide may sustain an increase in coronary blood flow and a reduction in oxygen delivery to the heart and brain. These factors may result in a decrement in man's performance in strategic and tactical weapon systems in an enemy defense environment. Since many of the stresses -- such as physical exertion, altitude hypoxia, and acceleration -- are cumulative, carbon monoxide may affect the heart and cardiovascular system of man during operational flying by decreasing still further the oxygen supply and reserve in the heart and brain. Author

N74-13790 Hopital d'Instruction des Armees, Versailles (France).
CARDIAC VALVULOPATHIES AND FLIGHT TOLERENCE [CARDIOPATHIES VALVULAIRES ET TOLERANCE AU VOL]
G. Leguay *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 12 p refs In FRENCH (For availability see N74-13784 05-04)

Due to exceptional circumstances 8 pilots suffering from aortic insufficiency, aortic stenosis, and mitralis stenosis have been on flying status, aeromedically monitored up to 15 and 20 years. The cardiac valvulopathies raise a twofold problem: they may potentially endanger flight safety by leading to a sudden cardiac syncope and they can be aggravated by flying, particularly by acceleration forces. Flight safety, however, has never been threatened by these aircrew in the light of experience over several years. The tolerance of flying pilots suffering from moderate aortic insufficiency seems satisfactory, in particular in fighter pilots exposed to high g-loads. Author

N74-13791 Centre Principal d'Expertises Medicales du Personnel Navigant, Paris (France).
VALUE OF CARDIAC MECHANOGRAMS IN EVALUATING FLYING PERSONNEL [INTERET DES MECANOGRAMMES CARDIAQUES DANS L'EXPERTISE DU PERSONNEL NAVIGANT]
R. Carre, C. Nogues, and B. Raviart *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 14 p refs In FRENCH (For availability see N74-13784 05-04)

Cardiac mechanograms provide useful information in the medical evaluation of aircrew and are obtained fast and easily by a noninvasive technique. The cardiogram itself provides an estimate of the elasticity of the arterial wall, and in that way gives criteria for atherosclerosis. The combined use of chronocardiographic methods (EGG, cardiogram) provides an opportunity of validating the contractibility of the cardiac muscle. These methods are important in the cardiologic survey of aircrew, both to detect atherosclerosis and monitor arterial hypertension. Author

N74-13792 Hopital d'Instruction des Armees, Versailles (France). Service de Medecine Aeronautique.
ASTHMA IN MILITARY FLYING PERSONNEL [L'ASTHME DANS LE PERSONNEL NAVIGANT MILITAIRE]
R. Pannier *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 8 p refs In FRENCH (For availability see N74-13784 05-04)

Detection of bronchial asthma is based mainly on actually observed acute episodes. That is the reason why applicants for flight training will be accepted unless they are subjected to an acetylcholin test. It is well known that patients with bronchial asthma benefit from flying. However, because of its serious consequences if it occurrs in flight, bronchial asthma is considered to jeopardize flight safety. It is important to realize that treatments have to be adapted to the aircrew tasks since some medications may be contraindicated for flying activities in view of their secondary effects. Therefore, applicants for flying duties suffering from bronchial asthma must be rejected; aircrew who develop bronchial asthma during an established career might be considered for a waiver on an individual basis, but as a rule they will not be authorized for primary control of aircraft. Author

N74-13793 Hopital d'Instruction des Armees, Versailles (France).
IDIOPATHIC SPONTANEOUS PNEUMOTHORAX IN FLYING PERSONNEL [LE PNEUMOTHORAX SPONTANE IDIOPATHIQUE DANS LE PERSONNEL NAVIGANT]
Roger Pannier *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 6 p In FRENCH (For availability see N74-13784 05-04)

Rupture of subpleural blebs is considered the most frequent cause of idiopathic spontaneous pneumothorax. Idiopathic spontaneous pneumothorax can occur in flight in the course of rapid decompression, by ascent to altitude both in flight and in an altitude chamber when trapped air within these blebs expands and ruptures the thin pleural layer, by an hydrostatic hemodynamic effect, or incidentally without any concomitant exertion or any physical stress. Applicants for flight training reporting one episode of idiopathic spontaneous pneumothorax must be rejected; aircrew on active duty and with an established flying career must be grounded unless they have undergone successful pulmonary surgery. Ten out of thirteen aircrew who suffered from idiopathic spontaneous pneumothorax were kept on flying status after successful pulmonary surgery. The time of grounding ranged from 3 to 14 months. Author

N74-13794 Centre d'Essais en Vol, Bretigny-sur-Orge (France).
AIRCREW'S FITNESS FOR FLYING DUTIES AFTER VERTEBRAL FRACTURES AND SPINAL SURGERY [APTITUDE AU VOL DU PERSONNEL NAVIGANT APRES FRACTURES DU RACHIS ET INTERVENTIONS CHIRURGICALES SUR LA COLONNE VERTEBRALE]
Roland-Paul Delahaye (Service de Sante pour l'Armee de l'Air, Paris), Robert Auffret, Jacques Mine (Hopital Begin, Saint-Mande), and Pierre-Jean Metges (Hopital Begin, Saint-Mande) *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 7 p refs In FRENCH (For availability see N74-13784 05-04)

Some features of flying such as vibration and accelerations, may sensitize the spine; ejection seat bail-out and/or crash can result in more or less deleterious spine injuries and fractures. After every accident, spinal disorders, or spinal surgery aircrew must be reexamined for flying fitness. After fractures it is of the utmost importance to determine the degree of spinal stability or instability, such as after spinal disorders e.g. osteoarthrosis or arthrosis, or surgery (laminectomy), or surgery for disc hernias or spondylolisthesis. Special emphasis has been given to the evaluation of aircrew with repeated vertebral traumas on damaged spines and fractures after surgery for spinal conditions. Author

N74-13795 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).
THE RISK OF MINOR SPINAL ABNORMALITIES IN AIRCREWS: EVALUATION OF EJECTION CASES
A. Beck *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 4 p refs (For availability see N74-13784 05-04)

An attempt has been made to determine pre-existing spinal abnormalities in aircrew which may have had a detrimental effect on the traumatic events, retrospectively, i.e. after fracture of the vertibral body had occured. The collection of these findings was compared with cases of ejection seat bailouts without injuries or fractures in order to recognize morphological alterations which may possible be conducive to fracture. Author

N74-13796 Advisory Group for Aerospace Research and Development, Paris (France).
AERONAUTICAL REHABILITATION OF FLYING PERSONNEL SUFFERING FROM ACUTE PSYCHIATRIC DISTURBANCES [LA REHABILITATION AERONAUTIQUE DES MEMBRES DU PERSONNEL NAVIGANT AYANT PRESENTE DES TROUBLES PSYCHIATRIQUES AIGUS]
R. Gelly and J. C. Hadni *In its* Pathophysiol. Conditions Compatible with Flying Oct. 1973 9 p In FRENCH (For availability see N74-13784 05-04)

Acute psychiatric symptoms combined with behavioral anomalies are normally aeromedical reasons for rejection both from flying and from regular military service. Based on an extensive case report survey, it can be demonstrated fairly clearly that such decisions are not always justified. Each case must be considered from an individual viewpoint, since in many cases psychiatric symptoms and behavioral anomalies cannot be diagnosed with absolute certainty. In particular, some obviously

serious crises merely reflect individual difficulties in the course of adaptation. Any decision must therefore be based on a diagnosis of the personality structure and personality tests must be considered a major element of psychopathological diagnosis. Psychotherapy can bring to a satisfactory solution some psychiatric syndromes which have been in the past considered irreversible. However, psychotherapy in order to be successful, must be associated with concurrent actions both in the professional environment and in further flying training, etc.. Under these conditions the rehabilitation for flying duties of aircrew who had acute psychiatric troubles, possible. Author

N74-13797 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).
IMPORTANCE OF THE 4 - 5 c/sec RHYTHM IN THE EEG TO DETERMINE MILITARY FLYING FITNESS
H. Oberholz *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 3 p refs (For availability see N74-13784 05-04)

The 4 - 5 c/sec rhythm is probably a genetically determined variant of the normal EEG which may easily be misinterpreted as a fairly serious general alteration of the EEG. In order to differentiate between similar EEG patterns, the characteristics of this EEG-variant and the special mode of EEG registration were discussed and appropriate EEG's demonstrated. From the literature, the results of family examinations including possible causes of these EEG-variants were presented. Psychological peculiarities in persons showing this EEG variant were emphasized and criteria for the assessment of military flying fitness and preventive measures were proposed. Cases found were analyzed and the procedures applied to variant carriers presented. Author

N74-13798 Centre Principal d'Expertises Medicales du Personnel Navigant, Paris (France).
OPHTHALMOLOGICAL SUPERVISION OF DIABETIC FLYING PERSONNEL [SURVEILLANCE OPHTALMOLOGIQUE DU PERSONNEL NAVIGANT DIABETIQUE]
J. P. Chevaleraud and G. Perdriel *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 5 p In FRENCH (For availability see N74-13784 05-04)

With reference to diabetes mellitus, the ophthalmologist's role can be twofold; through his special examinations he can detect this disorder very early and he can monitor its different forms, its several steps of evolution, and its implications for flying fitness. Based on broad clinically and functionally oriented knowledge and electrophysiological experience, some interesting proposals for the evaluation of aircrews who suffer from different forms of diabetes mellitus are reported. Author

N74-13799 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
MANAGEMENT OF GLAUCOMA IN AN AGEING FLYING POPULATION
Thomas J. Tredici, James L. Mims, III, and James F. Culver *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 3 p refs (For availability see N74-13784 05-04)

Ageing has definite and certain predictable effects on the visual apparatus. Loss of accommodation with age hampers important visual tasks in the cockpit. Disease processes that are common in any population will eventually also affect the flyer. The occurrence of narrow angle glaucoma in the flying population is so small that it is insignificant; however, with relative maturation of a flying force a 2 to 3 percent figure does become significant. Glaucoma strikes a flyer after a great deal of time and money have been expended in his training and when his experience could be utilized to the maximum. Medical grounding of a significant number of experienced flyers can be considered a loss. Many flyers with increased intraocular pressure have been retained on flying status by a rationale of diagnosis and treatment. The visual effects of drugs utilized in the treatment of glaucoma have been evaluated. Presently, only intraocular tension lowering drugs that do not effect visual function are being used. Author

N74-13800 Centre Principal d'Expertises Medicales du Personnel Navigant, Paris (France).
CURRENT ASPECTS OF COCHLEAR FUNCTION APPLIED TO FLYING PERSONNEL [ASPECT ACTUEL DE LA FONCTION COCHLEAIRE CHEZ LE PERSONNEL NAVIGANT]
P. Blanc and J. Bastien (DCSSA, Paris) *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 3 p In FRENCH (For availability see N74-13784 05-04)

This 9-years survey is based upon 6.024 audiograms of flying personnel who have been rated for at least two years. The results of this investigation can be summarized as follows: (1) Any barotrauma on the middle ear may be neglected; an air passenger who has had stapedectomy for otosclerosis may travel by air without any risk; (2) occupational deafness was not found in flying personnel under investigation; (3) hearing discrimination deficits were found in some individuals since the aviation operational envrionment stresses aircrew by its considerable noise levels; and (4) 12 aircrew with intact ear drums were found to be suffering from moderate conduction deafness and presenting the classic otosclerotic syndrome. Two of them underwent cochlear surgery and have flown to date 1.000 flying hrs each. The audiometric results produced by surgery remained excellent. Author

N74-13801 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).
PURE TONE HEARING LOSSES IN PILOTS OF VARIOUS AIRCRAFT, AGE AND FLYING TIME AND ITS SIGNIFICANCE FOR INFLIGHT SPEECH COMMUNICATION
G. H. Froehlich *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 4 p (For availability see N74-13784 05-04)

The punch cards of 2000 pilots investigated in 1971 have been separated into 4 groups of flying time respectively age, subdivided into pilots of jet aircraft, piston engined aircraft and helicopters. High tone hearing losses were increasing with age and flying time and in helicopter pilots more rapidly than in pilots of the other types of aircraft. A number of pilot's speech audiograms have been investigated. The intelligibility scores of hearing losses above 3000 Hz were excellent and there are no problems with inflight speech communications. Hearing losses above 2000 Hz resulted in intelligibility scores of 72% at low and 85% at medium speech levels. Less than 10% of the pilots above 45 years of age had hearing losses above 1500 Hz. At medium speech levels they obtained only a score of 70%, 100% are frequently not reached even with high speech levels. Together with the masking effect of inflight cabin noise, voice communication might be endangered, especially if the attenuation characteristics of headsets and flying helmets are poor. In these cases, the use of properly fitting headgar is especially important to insure a favorable noise to speech ratio. Author

N74-13802 Hopital d'Instruction des Armees, Versailles (France).
PROTEINURIAS IN FLYING PERSONNEL [PROTEINURIES ET PERSONNEL NAVIGANT]
G. Leguay *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 12 p In FRENCH (For availability see N74-13784 05-04)

Proteinurias have been found much more frequently among air transport aircrew than in fighter pilots. More than 50% of all cases have been observed in aircrew between 20 and 25 years of age which is obviously caused by the age dependant incidence of the orthostatic proteinuria. Chronic proteinurias are in most instances caused by chronic glomerulopathies. If this condition is clinically stabilized, it may be considered compatible with flying. Clearance impairment, however, necessitates a special diet, and the existence of a marked hypertension as well as the incompatibility with vaccinations indicates grounding of these aircrew. To verify the interaction of proteinurias and flying, several individuals were exposed to acceleration forces on the human centrifuge. No significant changes of proteinuria were observed during or after the centrifuge rides. However, barometric stresses which occur when flying at different altitudes may be considered dangerous since these barometric pressure differences can exacerbate infectious lesions in ENT areas. Author

N74-13803 School of Aerospace Medicine, Brooks AFB, Tex.
THE OCCURRENCE OF HYPERLIPIDEMIA IN FLYING AND NONFLYING SUBJECTS OF THE USAFSAM CAR-

DIOVASCULAR DISEASE STUDY

Dale A. Clark, Kenneth A. Narahara, and Margaret F. Allen *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 6 p refs (For availability see N74-13784 05-04)

The subjects of a cardiovascular disease study were separated into flying and non-flying groups, and the occurrence of elevated lipid levels in these groups was tabulated. The question of interest was whether the stresses of flight elevate serum cholesterol and predispose pilots to the development of atherosclerotic heart disease. None of the percentages obtained in this investigation differ significantly between the two groups. These data therefore indicate that the stresses associated with flying have no more effect on serum lipids than do the stresses experienced by a group of non-flying officers. A corollary inference is that the prognostic significance of a given serum lipid level is the same whether observed in a flying or a non-flying officer. Author

N74-13804 Advisory Group for Aerospace Research and Development, Paris (France).

THE PROBLEM OF DIABETES MELLITUS IN AVIATION MEDICINE

Gerhard Renftle *In its* Pathophysiol. Conditions Compatible with Flying Oct. 1973 7 p refs (For availability see N74-13784 05-04)

Problems in aviation medicine which diabetes mellitus raise regulations, waivers, diet, and hypoglycemic agents, are discussed. While the incidence rate is relatively low in student pilots, a higher number of cases is found during follow-up examinations among experienced senior or command pilots. Onset at age 20 to 40 may have the course of either juvenile or adult type. Annual evaluation of carbohydrate metabolism with a standard glucose tolerance test should be mandatory for every military or commercial pilot, and every private pilot after age 40. As sulfonylureas may cause hypoglycemia, any antidiabetic therapy should not be considered compatible with flying duties. Individuals with decreased carbohydrate metabolism tend to hypoglycemic reactions especially in hazardous situations or fasting periods. Waivers should be granted only for diabetic pilots whose carbohydrate metabolism is fully controlled with diet, confirmed by daily testing of urine and frequent postprandial blood sugar examinations. A case report illustrates the fluctuating and reversible course of an incipient diabetes and its effective management in a highly motivated and cooperative senior pilot. Author

N74-13805 School of Aerospace Medicine, Brooks AFB, Tex.

THE REPEATABILITY OF AN ABNORMAL 2-HOUR GLUCOSE TOLERANCE TEST

J. F. Trabal, R. G. Troxler, and M. C. Lancaster *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 5 p refs (For availability see N74-13784 05-04)

The diagnosis of diabetes mellitus not only implies a chronic abnormality of carbohydrate metabolism and an increased risk of premature vascular disease, but in the flyer, this diagnosis implies an increased risk to flying safety by reason of physical performance degradation. The glucose tolerance test (GTT) is the accepted standard for the diagnosis of nonmanifest diabetes. A study of the repeatability of the 2-hour GTT was carried out in 162 flyers who had an initial GTT and a repeat GTT from 6 - 24 months later. Of those initial tests considered abnormal, 55 to 60% reverted to normal on the repeat test. The repeatability of the GTT varied with the criteria used and with the number of points on the GTT curve that was considered. The effects of stress on glucose metabolism and the results of the modification of the criteria for the diagnosis of diabetes are discussed. The results of this study illustrate the importance of basic definitions of diagnostic criteria for diseases which have a long term effect on the health of the flying population. Author

N74-13806 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

GERMAN AIR FORCE EXPERIENCES WITH CERTAIN CRITERIA FOR GRANTING A WAIVER

Guenther Schirrmann *In* AGARD Pathophysiol. Conditions Compatible with Flying Oct. 1973 4 p refs (For availability see N74-13784 05-04)

During a period of 13 years there were 28,699 periodic physical examinations of aircrew with 602 granted waivers. These medical waivers were primarily granted in the disciplines of ophthalmology and internal medicine and seem to be justified even after a critical review. Prerequisite to this procedure is not only a profound medical knowledge and know-how, but also comprehensive flight surgeons' experience. A correlation of accidents/incidents caused by pilots with and without waivers indicates practically identical findings: while the aircraft accident rate was 3,76% for pilots flying without a waiver, it was 3,45% for pilots flying with a waiver and is therefore identical. An analysis of aircraft accidents involving the waiver group revealed no evidence indicating that waivers are a triggering or contributing factor in accidents. The procedure seems to be sufficient to eliminate all flying safety risks. Author

N74-13807*# Agricultural Research Service, Berkeley, Calif. Western Regional Research Lab.

ROTARY PLANT GROWTH ACCELERATING APPARATUS Patent Application

Richard R. Dedolph, inventor (to NASA) Filed 27 Dec. 1973 27 p Sponsored by NASA

(NASA-Case-ARC-10722-1; US-Patent-Appl-SN-428995) Avail: NTIS HC $3.50 CSCL 06C

A plant growth acceleration apparatus is reported wherein plants are grown in rotating beds driven in a planetary path about a primary axis so as to reduce the constraints of gravity upon the plants. NASA

N74-13808*# Techtran Corp., Glen Burnie, Md.

THE INFLUENCE OF THE UTRICLE AND THE EFFERENT VESTIBULAR ACTIVITY ON THE SPONTANEOUS AFFERENT ACTIVITY OF THE NERVES OF THE HORIZONTAL CANAL AND THE ANTERIOR VERTICAL CANAL IN THE FROG

J. Caston Washington NASA Jan. 1974 18 p refs Transl. into ENGLISH from J. Physiol. (Paris), v. 62, 1970 p 407-420 (Contract NASw-2485)

(NASA-TT-F-15253) Avail: NTIS HC $3.00 CSCL 06C

Spontaneous activity was studied in the horizontal and anterior semicircular canal nerves of the frog. Recordings were made with isolated heads (section being performed behind the medulla oblongata), in one group with the intact preparation, after section of the utricular nerve, and on the peripheral end of the cut ampullar nerve; in a second group with the intact preparation, after destruction of the encephalon, and with the peripheral end of the cut ampullar nerve. It was found that spontaneous activity decreases in most cases after section of the utricular nerve; decreases, increases, or remains the same after destruction of the encephalon; at the peripheral end of the cut nerve it always at least equals but mostly is greater than that recorded with the intact preparation and after the two previous tests. The ampullae of the horizontal and anterior canals are innervated by efferent fibers (some related to the utricle) and by collaterals from fibers of the utricular nerve. Author

N74-13809*# National Aeronautics and Space Administration, Washington, D.C.

THE DYNAMIC BEHAVIOR OF THE EAR IN SEPARATING THE SOUND SPECTRUM INTO FREQUENCY GROUPS

H. Scholl Dec. 1969 12 p refs Transl. into ENGLISH from Acustica (Stuttgart), v. 12, 1962 p 101-107

(NASA-TT-F-12719) Avail: NTIS HC $3.00 CSCL 06P

Together with the inherent persistence of the ear, the spectral separation of sound into frequency groups is an important factor in the formation of the masking thresholds of wideband pulses (white noise pulses, pressure pulses). The requisite high selectivity of the ear is not continuously present but is built up within a certain interval of time after incidence of the sound. Thus sounds of very short duration are not spectrally separated at all; their masking thresholds are determined by the total energy. On the other hand, with long pulses or continuous sounds, as a result of spectral separation, the intensity of only a single frequency group is fully effective. The time required for the ear to separate the sound spectrum into frequency groups, about 10 ms, is measured directly using a special scanning method. The masking thresholds of sound pulses as a function of pulse duration calculated from these data are in good overall agreement with measured masking thresholds. Author

N74-13810*# Techtran Corp., Glen Burnie, Md.
MACROMETRIC CHANGES IN THE MAKEUP OF THE HUMAN BODY IN HYPODYNAMIA
A. G. Zhdanova Washington NASA Jan. 1974 11 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. i Embriol. (Moscow), v. 29, no. 12, 1965 p 29-34
(Contract NASw-2485)
(NASA-TT-F-15252) Avail: NTIS HC $3.00 CSCL 06P

Changes were studied in human organism produced by 2-, 5-, 7- and 10-day long hypodynamia, affecting general weight of the body, its fat, nonfat components, and specific weight of the body. It is suggested that hypodynamia results in a relative atrophy of the skeletal muscles, which may be of a considerable hindrance for the organism, especially at the moment of landing, when the nervous-muscular activity begins to be activated, and later on with readaptation to the conditions of the ground existence. Consequently, preservation and maintenance of adaptive reactions of the muscular and other systems to the effect of gravity are an important prerequisite for a successful issue of durable flights connected with forced conditions of hypodynamia and weightlessness andfor return to earth gravitation. Author

N74-13811*# Linguistic Systems, Inc., Cambridge, Mass.
DEFICIENCY IN RETENTION OF CONDITIONING AFTER DEPRIVATION OF PARADOXICAL SLEEP IN RATS
Pierre Leconte and Vincent Bloch Washington NASA Jan. 1974 8 p refs Transl. into ENGLISH from Compt. Rend. (Paris), Ser. D, v. 271, 15 Jul. 1970 p 226-229
(Contract NASw-2482)
(NASA-TT-F-15223) Avail: NTIS HC $3.00 CSCL 06C

Forty-eight hours' elective and total deprivation of paradoxical sleep disturbed the retention of conditioning in the rat. There is less disturbance with partial deprivation (50%) of the same duration. However, after such privation, the capability of reacquiring the same learning does not seem altered. Thus paradoxical sleep would seem to play a part in the stabilization mechanisms of the memory trace. Author

N74-13812*# Linguistic Systems, Inc., Cambridge, Mass.
EFFECT OF ACQUISITION LEVEL ON INCREASED PARADOXICAL SLEEP DURATION DUE TO AVOIDANCE CONDITIONING IN THE RAT
Elisabeth Hennevin, M. M. Pierre Leconte, and Vincent Bloch Washington NASA Jan. 1974 8 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Ser. D (France), v. 273, 1971 p 2595-2598
(Contract NASw-2482)
(NASA-TT-F-15221) Avail: NTIS HC $3.00 CSCL 06C

The increase in the duration of paradoxical sleep after learning augments with the order of sessions up to the platform of the learning task where it stops. After each session the increase in paradoxical sleep is manifested only for 30 minutes after falling asleep. Author

N74-13813*# Techtran Corp., Glen Burnie, Md.
PROBLEMS OF SPACE BIOLOGY. VOLUME 22: METABOLISM UNDER THE EXTREME CONDITIONS OF SPACE-FLIGHT AND DURING ITS SIMULATION
I. S. Balakhovskiy and Yu. V. Natochin Washington NASA Dec. 1973 195 p refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii. Tom 22: Obmen Veshchestv v Ekstremalnykh Usloviyaka Kosmicheskogo Poleta i Pri Yego Imitatsii" Moscow, Nauka, c. 1968 212 p
(Contract NASw-2485)
(NASA-TT-F-15163) Avail: NTIS HC $11.75 CSCL 06S

The book summarizes the experience of ten years of study of the metabolic processes in cosmonauts who have flown aboard Soviet spacecraft. The changes observed in them are compared with the results obtained in model experiments and data published by the American researchers. The excretion of water and salts directly during the flight and immediately after landing in analyzed in detail. The methodological section of the book deals with a detailed description of the methods of clinical biochemistry, specially devised and applied to problems of space medicine: the complex microchemical analysis of blood dried on pieces of paper, determination of the mass of hemoglobin, etc. General problems of water transport in osmoregulatory organs and the regulation of water-salt exchange are discussed. Author

N74-13814# Naval Postgraduate School, Monterey, Calif.
FLUID FLOW IN THE LUNG: A SURVEY. NUMERICAL SOLUTION FOR GAS MIXING IN A SIMPLE MODEL OF THE LUNG, AND EXPERIMENTAL STUDY OF FLOW IN A THIN WALLED COLLAPSIBLE TUBE M.S. Thesis
Jan David Janiec Jun. 1973 67 p refs
(AD-767638) Avail: NTIS CSCL 06/16

The range of fluid dynamics applications in the lung is vast, encompassing many interesting problems rarely touched in any other single engineering area. A survey of recent work in this field was a simple model of the lung was developed indicating its application to a wide range of similar problems. Finally, new parameters were experimentally investigated in flow through a thin-walled collapsible tube. Results indicated the effects of the parameters to be significant in the flow of blood in the pulmonary capillaries as controlled by the surrounding aveolar pressure. Author (GRA)

N74-13815# Payne, Inc., Annapolis, Md.
A STATISTICAL STUDY OF GRIP RETENTION FORCE Final Report, 30 Jun. 1971 - 2 Mar. 1973
Theodore W. Horner and Fred W. Hawker Wright-Patterson AFB, Ohio AMRL May 1973 48 p refs
(Contract F33615-71-C-1892; AF Proj. 7231)
(AD-767904; Working-Paper-101-11; AMRL-TR-72-110) Avail: NTIS CSCL 06/19

To assess an ejection seat occupant's ability to hold on to a handle the data from the two-handed force retention capability tests of Garrett, Alexander and Bennett are analyzed to produce curves of probability of letting go as a function of force. Two curves are produced; one for double grip handles, comprising a T-Bar and a Twin Grip; and one for Rings, comprising a flexible loop and the familiar, rigid D-Ring. It is concluded that, at the force levels experienced in most present-day ejections, which occur at low and moderate air speeds, the probability of letting go a ring is an order of magnitude greater than for a double grip handle. It is concluded that handle design strongly influences the probability of letting go, and therefore the probability of arm flail injury. Author (GRA)

N74-13816# Rochester Univ., N.Y.
EFFECT OF EXTREMELY LOW FREQUENCY ELECTRIC AND MAGNETIC FIELDS ON ROOTS OF 'VICIA FABA' Final Report
Morton W. Miller 2 Oct. 1973 10 p refs
(Contract N00014-67-A-0398-0011)
(AD-767387) Avail: NTIS CSCL 20/3

Roots of Vicia faba were exposed to electric and magnetic fields comparable to those of Project SANGUINE. There were no differences among control and exposed roots for growth or mitotic index. Also, there were no chromosomal anomalies. Author (GRA)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N74-13817*# BioTechnology, Inc., Los Altos, Calif.
SIMULATOR EVALUATION OF DISPLAY CONCEPTS FOR PILOT MONITORING AND CONTROL OF SPACE SHUTTLE APPROACH AND LANDING. PHASE 2: MANUAL FLIGHT CONTROL Final Report
Walter B. Gartner and Kenneth M. Baldwin Washington NASA Dec. 1973 83 p refs
(Contract NAS2-6460)
(NASA-CR-2359) Avail: NTIS HC $3.75 CSCL 05E

A study of the display requirements for final approach management of the space shuttle orbiter vehicle is presented. An experimental display concept, providing a more direct, pictorial representation of the vehicle's movement relative to the selected approach path and aiming points, was developed and assessed as an aid to manual flight path control. Both head-up, windshield projections and head-down, panel mounted presentations of the

experimental display were evaluated in a series of simulated orbiter approach sequence. Data obtained indicate that the experimental display would enable orbiter pilots to exercise greater flexibility in implementing alternative final approach control strategies. Touchdown position and airspeed dispersion criteria were satisfied on 91 percent of the approach sequences, representing various profile and wind effect conditions. Flight path control and airspeed management satisfied operationally-relevant criteria for the two-segment, power-off orbiter approach and were consistently more accurate and less variable when the full set of experimental display elements was available to the pilot. Approach control tended to be more precise when the head-up display was used; however, the data also indicate that the head-down display would provide adequate support for the manual control task. Author

N74-13818*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REFERENCE APPARATUS FOR MEDICAL ULTRASONIC TRANSDUCER Patent Application
Robert D. Lee, Robert J. Hudock, and Dale I. Shute, inventors (to NASA) Filed 21 Dec. 1973 18 p
(NASA-Case-ARC-10753-1; US-Patent-Appl-SN-427395) Avail: NTIS HC $3.00 CSCL 06B

A portable miniature ultrasonic transducer positioning apparatus is described having a transducer receiving sleeve coupled to a pair of orthogonally orientated, independently pivotable yokes. The yokes are pivotably mounted to a base member the under surface of which is fitted with a non-skid rubber cap. A pair of potentiometers are coupled to the axes of the yokes and to a dual meter sleeve position indicator for indicating the angular position of a probe slidably fitted in the sleeves. An oscilloscope or similar signal display device is coupled to the probe for providing signal readout from the probe for use in ultrasonic cardiology oscilloscope studies. NASA

N74-13819*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METABOLIC ANALYZER
Cortes L. Perry 26 Dec. 1973 28 p
(NASA-TM-X-64797) Avail: NTIS HC $3.50 CSCL 06B

An apparatus is described for the measurement of metabolic rate and breathing dynamics in which inhaled and exhaled breath are sensed by sealed, piston-displacement type spirometers. These spirometers electrically measure the volume of inhaled and exhaled breath. A mass spectrometer analyzes simultaneously for oxygen, carbon dioxide, nitrogen, and water vapor. Circuits responsive to the outputs of the spirometers, mass spectrometer, temperature, pressure, and timing signals compute oxygen consumption, carbon dioxide production, minute volume, and respiratory exchange ratio. A selective indicator provides for readout of these data at predetermined cyclic intervals. Author

N74-13820# Army Aviation Systems Test Activity, Edwards AFB, Calif.
STUDY: PILOT PERCEIVED JETTISON ENVELOPE Final Report
Albert L. Winn and James S. Kishi Jun. 1973 29 p refs
(AD-768171; USAASTA-71-03) Avail: NTIS CSCL 05/10

The OH-6A, OH-58A, and AH-56A helicopters were evaluated to determine pilot sensed sideslip cues with respect to their influence on the jettison of external stores. The data were necessary to confirm previous studies with the UH-1C and CH-47C helicopters, and to expand the data to other helicopters and operating conditions. Tests were conducted at the United States Army Aviation Systems Test Activity, Edwards Air Force Base, California and at Yuma Proving Ground, Arizona. Additionally, data previously obtained for other test helicopters were analyzed to determine variation in static lateral-directional stability with altitude, gross weight, rotor speed, and center-of-gravity location. Results confirm that side force is the most significant cue to pilot recognition of uncoordinated flight. The pilots evaluation of side force was consistent for all aircraft and all test cases. During this evaluation, the pilots recognized lower side force values than during the UH-1C and CH-47C evaluations. Data analysis shows helicopter side-force characteristics to be relatively independent of atmospheric or operating conditions other than airspeed and sideslip angle. Helicopter lateral-directional stability characteristics and pilot recognition of side force can be combined to predict a minimum required jettison envelope for theoretical or actual flight vehicles. This procedure can be used for early definition of problem areas and to reduce the cost and risk associated with establishing flight envelopes.
Author (GRA)

N74-13821# Dunlap and Associates, Inc., Inglewood, Calif. Western Div.
EFFECT OF A PREDICTOR DISPLAY ON CARRIER LANDING PERFORMANCE. PART 2: LABORATORY MECHANIZATION Final Report
Louis E. Ehrhardt, Frank R. Cavallero, and Robert S. Kennedy Jun. 1973 44 p refs 2 Vol.
(Contract N00014-71-C-0252; NR Proj. 196-106)
(AD-767983) Avail: NTIS CSCL 05/9

A three-phase program was conducted to determine the effect of a predictor display on carrier landing performance. Part 2 describes the laboratory mechanization for the experiment in detail. Pilot's night carrier landing approach performance was measured as altitude and lateral error from glideslope and centerline using the predictor display, the baseline display and a glideslope reference element of the predictor display. The predictor display proved to be superior to the baseline display. It reduced vertical and lateral error variability during approach, increased the number of approaches within a joint FLOLS/lateral error envelope, increased the number of acceptable approaches and produced approaches less variable than those observed in the fleet. The baseline display was found to be a valid simulation of the night carrier landing task. The glideslope reference element was found to contribute to the superiority of the predictor display but was judged inadequate as an independent display. Further development of the predictor display for introduction to the fleet is recommended. (Modified author abstract) GRA

N74-13822# Dunlap and Associates, Inc., Inglewood, Calif. Western Div.
EFFECT OF A PREDICTOR DISPLAY ON CARRIER LANDING PERFORMANCE. PART 1: EXPERIMENTAL EVALUATION Final Report
Joseph W. Wulfeck, Daniel J. Prosin, and William J. Burger Jun. 1973 93 p refs 2 Vol.
(Contract N00014-71-C-0252; NR Proj. 196-106)
(AD-767982) Avail: NTIS CSCL 05/9

A three-phase program was conducted to determine the effect of a predictor display on carrier landing performance. Phase A consisted of display development. Phase B consisted of display mechanization, informal preliminary experimentation and development of a detailed design for a formal experiment in Phase C to compare the predictor to a baseline display in a fixed-based F4 simulator with carrier qualified pilots as subjects. The report concludes the program. Part I presents the results of the experiment conducted in Phase C. (Modified author abstract) GRA

N74-13823# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
DEFINITION OF REVERSE OSMOSIS REQUIREMENTS FOR SPACECRAFT WASH WATER RECYCLING
David F. Putnam and George W. Wells Nov. 1972 165 p refs
(Contract DI-14-30-3062)
(PB-222943/3; MDC-G3780; Int-OSW-RDPR-73-861) Avail: NTIS HC $10.25 CSCL 06K

The report defines and evaluates a six-man, reverse osmosis wash water recovery system that offers the dual advantages of lower equivalent weight and lower cost than competing wash water recovery techniques. The system meets the basic requirements of the advanced Skylab, the MDAC six man modular space station, and the Space Station Prototype (SSP) program. This report contains in-depth discussions of these major design considerations: Wash water requirements: compatible cleansing agents; A theoretical estimate of the contaminants found in wash water; A standard procedure for producing used wash water; Wash water standards. (Modified author abstract) GRA

06 CHEMISTRY

Includes chemical analysis and identification (e.g. spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N74-13824 Lehigh Univ., Bethlehem, Pa.
THE REACTION OF ALUMINUM WITH H2O AND D2O Ph.D. Thesis
Narayan Das 1973 190 p
Avail: Univ. Microfilms Order No. 73-23795

The interaction of Al with liquid H2O and D2O was investigated. A mechanism is offered to explain the growth of hydrated oxide on Al in H2O. The proposed mechanism is as follows: Aluminum is covered with a thin, continuous barrier film of Al2O3 when it is exposed to air. Shortly after the immersion of aluminum in liquid water, the outer surface of the Al2O3 becomes hydroxylated to form AlOOH. Protons in the hydrated film migrate to the metal-oxide interface under a concentration gradient, where electrons are furnished to form hydrogen atoms. Vacuum extraction, proton-proton scattering, and mass spectrometric analysis revealed the penetration of hydrogen and deuterium into aluminum during the reaction with H2O and D2O. The effect of pH and pD on the rate of corrosion of aluminum in H2O and D2O was determined. Cravimetric studies and infrared reflectance spectroscopy showed that the initial rate of reaction is logarithmic, followed by a linear rate of reaction.
Dissert. Abstr.

N74-13825*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRAPPING OF HYDROGEN ATOMS IN X-IRRADIATED SALTS AT ROOM TEMPERATURE AND THE DECAY KINETICS
Charles E. May, Warren H. Philipp, and Stanley J. Marsik Washington Jan. 1974 13 p refs
(NASA-TN-D-7413; E-7540) Avail: NTIS HC $2.75 CSCL 07E

The salts (hypophosphites, formates, a phosphite, a phosphate, and an oxalate) were X-irradiated, whereby hydrogen formed chemically by a radiolytic process becomes trapped in the solid. By room temperature vacuum extraction, the kinetics for the evolution of this trapped hydrogen was studied mass spectrometrically. All salts except two exhibited second-order kinetics. The two exceptions (NaH2PO2(H2O) and K2HPO4) showed first-order kinetics. Based on experimental results, the escape of hydrogen involves three steps: the diffusion of hydrogen atoms from the bulk to the surface, association of these atoms on the surface (rate controlling step for second-order hydrogen evolution), and the desorption of molecular hydrogen from the surface. The hydrogen does not escape if the irradiated salt is stored in air, apparently because adsorbed air molecules occupy surface sites required in the escape mechanism. Author

N74-13826# Scientific Translation Service, Santa Barbara, Calif.
SPECTRAL METHODS OF DETERMINING BERYLLIUM IN AIR, WATER AND BIOLOGICAL MATERIALS
T. K. Aydarov, A. Kh. Razyapov, and O. B. Znamenskaya [1973] 6 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), Nov. 1972 p 83-85 Sponsored by EPA
(HS-80) Avail: NTIS HC $3.00

Spectral methods for determining Be concentrations in air, water, and biological materials are outlined. Methods discussed include colorimetric, fluorescent, chromatographic, emission spectrography, and atomic absorption and fluorescent spectrophotometry. E.H.W.

N74-13827# Kanner (Leo) Associates, Redwood City, Calif.
SAMPLING AND ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS IN AUTOMOBILE EXHAUST GAS. 2: SEPARABILITY OF THE MIXTURE OF ALL POLYCYCLIC AROMATIC HYDROCARBONS, REPRODUCIBILITY OF THE METHOD, DISCUSSION
Gernot Grimmer, Armin Hildebrandt, and Heinz Bohnke Aug. 1973 16 p Transl. into ENGLISH from Erdoel kohle (Hamburg), v. 25, no. 9, Sep. 1972 p 531-536 Sponsored by Air Pollution Technical Inform. Center
(TR-33-74) Avail: NTIS HC $3.00

For the quantitative determination of polycyclic aromatic hydrocarbons capillary gas chromatography or the separation on packed high performance columns is used. The evaluation is carried out by comparison of the FID signals with added inner standards. For the determination of 12 hydrocarbons gas chromatographic method can be replaced by utilizing extinction differences of the UV spectrum after column chromatographic separation on aluminum oxide. The reproducibility of the driving program and of the method of determination was checked by comparison of 4 tests on a vehicle under otherwise equal conditions. One vehicle each of the categories with reference weights from 850 to 1020 kg, 1470 to 1700 kg, and 1700 to 1930 kg was checked. The deviation for 12 hydrocarbons in the series of 4 tests was about 15% from the mean value.
Author

N74-13828*# Beckman Instruments, Inc., Anaheim, Calif. Advanced Technology Operations.
AUTOMATED IODINE MONITOR SYSTEM Final Report
19 Nov. 1973 17 p
(Contract NAS9-13479)
(CR-134163; FR-1150-101) Avail: NTIS HC $3.00 CSCL 07D

The feasibility of a direct spectrophotometric measurement of iodine in water was established. An iodine colorimeter, was built to demonstrate the practicality of this technique. The specificity of this method was verified when applied to an on-line system where a reference solution cannot be used, and a preliminary design is presented for an automated iodine measuring and controlling system meeting the desired specifications. An Automated iodine monitor/controller system based on this preliminary design was built, tested, and delivered to the Johnson Space Center. Author

N74-13829# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
CATALYTIC ACTIVITY OF RARE-EARTH OXIDES FOR THE OXIDATION OF HYDROGEN
Larry J. Nicks and D. J. MacDonald 1973 12 p refs
(BM-RI-7841) Avail: NTIS HC $3.00

The Bureau of Mines is investigating the catalytic activity of rare-earth compounds to develop a catalyst for the cathode reaction of a hydrogen-oxygen fuel cell. Results of studies of the catalytic activities of lanthanide oxides for the oxidation of hydrogen at 150 to 250 C are presented. Preliminary activity tests were made with approximately stoichiometric mixtures of hydrogen and oxygen diluted with helium. A series of tests was also run under oxygen-rich conditions in which specific rate constants and activation energies were determined. Variations in rate constants up to 2,000 times were observed for the various lanthanide oxides. The three most active catalysts were oxides of Ce, Pr, and Eu, having specific activities of 6.93 X 10 to the -7 power, 4.88 X 10 to the -7 power, and 4.06 X 10 to the -7 power moles H2 X 1/sec X m to the -2 power, respectively, at 200 C. Author

N74-13830*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPABLE IMAGES PRODUCED BY X-RAYS USING THE NICKEL-HYPOPHOSPHITE SYSTEM. 3: THE LATENT IMAGE AND TRAPPED HYDROGEN
Charles E. May, Warren H. Philipp, and Stanley J. Marsik Washington Jan. 1974 18 p refs
(NASA-TN-D-7412; E-7502) Avail: NTIS HC $2.75 CSCL 07D

The hydrogen trapped in X-irradiated hypophosphites, phosphites, formates, oxalates, a phosphate, and some organic compounds was vacuum extracted and measured quantitatively with a mass spectrometer. After extraction, normally developable salts were found to be still developable. Thus, the latent image is not the trapped hydrogen but a species of the type HPO(-)2. The amplification factor for irradiated hypophosphites is about 100. A narrow range of wavelengths (at about 0.07 nm, 0.7 A) is responsible for the formation of the latent image. Author

N74-13831# State Univ. of New York, Buffalo. Dept. of Chemistry.
STUDIES IN SOLUTION AND NUCLEAR CHEMISTRY Final Report
J. A. Marinsky 1 Jul. 1973 44 p refs
(Contracts AT(11-1)-3469; AT(30-1)-2269)
(COO-3469-1) Avail: NTIS HC$4.25

A summary is presented of research that was conducted: (1) to elucidate the ion-exchange phenomenon; (2) to study the solution chemistry of the alkali metals, the alkaline earths, and the transition elements in the presence of linear and cross-linked polyelectrolytes; (3) to investigate the solution chemistry of the alkali metal and the lighter rare earth metal ions; and (4) to extend theoretical development of polyelectrolyte models for the knowledgeable interpretation of experimental results under items (1) and (2). Various ion-forms of Dowex-50 and IRC-50, their polyelectrolyte analogs, polystyrene sulfonic acid and polymethacrylic acid as well as polyacrylic, polyglutamic, and polyaspartic acid were used to facilitate these objectives. In addition, an investigation of the ion-selectivity of Linde-A zeolite in aqueous and mixed media was conducted to facilitate attainment of objective 1. An estimate of the physical chemical behavior of mixtures of alkali metal salts in aqueous and mixed media was provided by these studies. Author (NSA)

N74-13832# Lyon Univ. (France).
STUDY OF H2-D2 ISOTOPIC EXCHANGE CATALYZED BY NICKEL AND ZINC OXIDES Ph.D. Thesis
S. Richard 1972 131 p refs In FRENCH
(FRNC-TH-367) Avail: AEC Depository Libraries $8.75

These oxides have very different properties (nickel oxide is an electrical insulator and zinc oxide is an n type semiconductor). Nickel oxide is not very active at -196 C in the H2-D2 exchange reaction effected with freshly prepared catalysts. On the other hand, the solid becomes very active at -196 C after a reheating at 25 C in the presence of hydrogen. This phenomenon is explained by the absorption at 25 C of hydrogen species having a participation in the reaction at -196 C. Studies of the activity of partially reduced nickel oxide at -78 C demonstrated that exchange on the oxide itself occurs at this temperature. H2-D2 isotopic exchange effected in contact with zinc oxide at 0 C presents similar characteristics to that carried out with nickel oxide at -196 C. The exchange takes place through a Boreskov-Vassilevitch or Rideal mechanism. A fraction of the hydrogen is absorbed in the form of atoms, the reaction necessitating the presence of two active neighboring sites in the solid. NSA

N74-13833# South Carolina Univ., Columbia. Coll. of Engineering.
SYNERGISTIC SOLVENT EXTRACTION Progress Report, 1 Jul. 1972 - 30 Jun. 1973
M. W. Davis, Jr. 24 Jul. 1973 10 p refs
(Contract AT(38-1)-763)
(SRO-763-1) Avail: NTIS HC $3.00

The development and analysis of distribution data for the rare earths in the synergistic system kerosene-HTTA-TBP-dilute HNO3 has continued during the past year. The ionic strength itself does not appear to have a strong effect on the distribution coefficient. A 16 stage mini mixer settler together with all peripheral equipment, such as feed pumps, feed tanks, air motor drive, etc., was obtained during the year. The 16 stage mini mixer settler was received very recently. Corrosion studies of 304 ELC stainless steel in solutions of nitric acid saturated with HTTA and TBP indicate a low corrosion rate of 11.3 microns/ear at 25 C. The corrosion rate in two-phase systems such as will exist under process conditions was appreciably lower. Author (NSA)

N74-13834# Little (Arthur D.), Inc., Cambridge, Mass.
ELECTROCHEMICAL INTERACTION OF METALS WITH FLAME PLAMAS Final Report, Jun. 1972 - Jun. 1973
John M. Ketteringham, James D. Birkett, and Joan B. Berkowitz Aug. 1973 34 p refs
(Contract DAHC04-72-C-0027)
(AD-767283; AROD-10160-1-MC) Avail: NTIS CSCL 07/4

Techniques have been developed to study the electrochemical interaction of metals and alloys with flame plasmas. Scanning electron microscopy showed that positive polarization of nickel in a sodium sulfate seeded propane air flame at 975C retards corrosion, whereas negative polarization accelerates corrosion. No such effect was observed for nickel at 1,075C or nichrome at either temperature. The impressed current density at these applied voltages is much less than the equivalent corrosion rate; this leads us to suggest that the mechanism involves the suppression or enhancement of the reduction of sulfate to sulfide (or sulfur) at the metal surface. Such reduced species are known to be responsible for accelerated hot corrosion of nickel alloys. Author (GRA)

N74-13835# AeroChem Research Labs., Inc., Princeton, N.J.
MASS SPECTROMETRIC STUDY OF COMBUSTION PLASMA Final Report, 1 Aug. 1971 - 31 Jul. 1973
William J. Miller Sep. 1973 48 p refs
(Contract N00014-72-C-0053; NR Proj. 092-515)
(AD-767719; AeroChem-TP-300) Avail: NTIS CSCL 07/4

Premixed laminar combustion flames have been used in this program as a medium in which to study the ion chemistry of a number of metals of potential importance as rocket propellant additives or fuel constituents. The study included examination of (1) the thermochemistry of molybdenum, vanadium and chromium-containing negative ions (2) the kinetics of electron attachment to HBO2 and HCl and (3) the charged species chemistry of aluminum compounds at high temperatures. (Modified author abstract) GRA

N74-13836# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
HYDROCARBON-TYPE ANALYSIS OF GASOLINE USING STABILIZED OLEFIN ABSORPTION AND GAS CHROMATOGRAPHY Final Report
Leo L. Stavinoha Sep. 1973 17 p refs
(Contracts DAAK02-73-C-0221; DAAD05-72-C-0053)
(AD-767560; AFLRL-23) Avail: NTIS CSCL 07/3

A gas chromatographic technique has been evaluated for the precise determination of the saturate, olefin, and aromatic composition of motor gasoline. This procedure extends the capability of a test technique used to isolate the aromatic and saturate-olefin fractions of gasoline through the addition of a dual-column valve, olefin-absorber column, and humidified carrier gas for olefin-absorber stabilization in a 60C, temperature-controlled oven. The precutting column and the backflush valve used to isolate the aromatic fraction from the saturate-olefin fraction were located in a separate 120C, temperature-controlled oven. Two precise sample injections using a high-pressure/high-temperature valve are required to determine the peak areas attributed to the saturate fraction and to the olefin fraction. For volumetric analyses, the aromatic concentration was determined by comparing the aromatic peak with that of a standard. The remaining concentration of the sample was assigned to the saturate and olefin fractions based on the area attributed to each. The precision of this technique has been evaluated for 12 gasolines having olefin and aromatic concentrations ranging from 2 and 9 to 46 and 50 percent volume, respectively. Data from and advantages of this technique are compared to that of other hydrocarbon techniques. Author (GRA)

N74-13837# Illinois State Water Survey, Urbana.
SILICATE TREATMENT TO INHIBIT CORROSION OF HOT, POTABLE WATER SYSTEMS Technical Report on Phase 2, Jan. 1971 - Apr. 1973
R. W. Lane, C. H. Neff, and S. W. Schilsky Kirtland AFB, N. Mex. AFWL Sep. 1973 108 p refs
(Contract F29601-69-C-0071; AF Proj. 683M)
(AD-767902; AFWL-TR-73-84) Avail: NTIS CSCL 07/1

In the second phase of the study to determine effective chemical treatment to inhibit corrosion of metals in domestic hot water systems, it was concluded that sodium silicate treatment is still the best means of inhibiting corrosion of galvanized steel, copper, and copper nickel in 140F and 180F systems. Further testing was deemed necessary to determine whether tannin or zinc ion will improve the inhibition by silicate treatment. Zinc polyphosphate and zinc-phosphate formulations were found to be effective in reducing the corrosion of copper base metals. Systematic investigation of the variables (pH, treatment levels and water constituents) was considered necessary to determine

the optimal pH and inhibiting treatment concentrations for a particular water quality. Author (GRA)

N74-14272* New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
REDUCTION OF NO FORMATIONS BY PREMIXING
Antonio Ferri *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 10 p ref (For availability see N74-14271 05-20)
(Grant NGR-33-016-131)

N74-14277 Bonn Univ. (West Germany). Inst. fuer Physikalische Chemie.
PHOTO-OXIDATION OF AIRCRAFT ENGINE EMISSIONS AT LOW AND HIGH ALTITUDES
K. H. Becker and U. Schurath *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 9 p refs (For availability see N74-14271 05-20)

N74-14280 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.
A NEW ANALYTICAL TECHNIQUE FOR CONTINUOUS NO DETECTION IN THE RANGE FROM 0.1 TO 5000 PPM
H. Meinel and Th. Just *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 5 p refs (For availability see N74-14271 05-20)

N74-14287 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.
NO FORMATION IN FUEL RICH FLAMES: A STUDY OF THE INFLUENCE OF THE HYDROCARBON STRUCTURE
K. H. Eberius and Th. Just *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 8 p refs (For availability see N74-14271 05-20)

N74-14289 National Gas Turbine Establishment, Pyestock (England).
SOOT FORMATION IN RICH KEROSINE FLAMES AT HIGH PRESSURE
F. H. Holderness and J. J. Macfarlane *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 9 p refs (For availability see N74-14271 05-20)

N74-14290 Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
SOOT OXIDATION KINETICS AT COMBUSTION TEMPERATURES
John P. Appleton *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 11 p refs (For availability see N74-14271 05-20)
(Grant NSF GK-33933)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N74-13838 Department of Energy, Mines and Resources, Ottawa (Ontario). Earth Physics Branch.
TELEPHONE VERIFICATION SYSTEM FOR AUTOMATIC MAGNETIC OBSERVATORIES, VOLUME 44, NUMBER 5
F. Andersen 1973 10 p refs
Copyright. Avail: Issuing Activity

Automatic magnetic observatories at many locations across Canada sample the various components of the geomagnetic field once per minute and record the measurements in digital form on magnetic tape. A system which permits the operation of a remote automatic magnetic observatory to be monitored in Ottawa at any time, by means of commercial telephone circuits is described. Author

N74-13839 Syracuse Univ., N.Y.
A STUDY OF INFORMATION FEEDBACK COMMUNICATION SYSTEMS Ph.D. Thesis
Anthony F. Culmone 1972 106 p
Avail: Univ. Microfilms Order No. 73-19795

Techniques for the analysis and design of feedback communication systems that are subjected to certain constraints on the transmitter were developed. The constraint of particular interest is a power limitation. Pontryagin's maximum principle is used to develop an optimum linear system. The linear system has the disadvantage of requiring a transmitter capable of delivering unlimited power. The design technique fails, because of loss of system linearity, when a peak power constraint is placed on the transmitter. With these difficulties in mind, an information theoretic design approach is applied to the same linear system. This approach is then developed further and is used to design a more general class of feedback systems. The general result is applied to a few specialized systems, including one in which the transmitter is contrained to operate at a constant power level. Performance Comparisons are made for the specialized systems studied and a system developed by another author.
Dissert. Abstr.

N74-13840 British Broadcasting Corp., Kingswood (England). Research Dept.
VISIBILITY OF CHROMINANCE/LUMINANCE DELAY INEQUALITY IN SYSTEM 1 (625-LINE PAL) VIDEO SIGNALS
V. G. Devereux and G. C. Wilkinson Nov. 1973 7 p refs (BBC-RD-1973/35) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

An investigation, including subjective tests, was carried out concerning the visibility of chrominance/luminance delay inequalities in System 1 (625-line PAL) video signals. The results obtained indicate that the threshold of visibility of this type of picture impairment corresponds to a delay inequality of about + or - 50 ns on critical pictures if it results from timing errors in a video circuit handling separate chrominance (R-Y and B-Y) and luminance (Y) signals; if, however, the delay inequality is caused by group delay distortion in a circuit handling coded PAL signals, the threshold occurs at about + or - 100 ns. Author

N74-13841 Virginia Polytechnic Inst. and State Univ., Blacksburg.
DEPOLARIZATION EFFECTS OF RAINFALL ON MILLIMETER WAVE PROPAGATION Ph.D. Thesis
Paris Herschel Wiley 1973 92 p
Avail: Univ. Microfilms Order No. 73-23438

Weather--especially precipitation--is a major consideration in the design of millimeter wave communications systems. The two major effects of weather are attenuation and depolarization of a transmitted wave due to rainfall. Since raindrops tend to be elongated, an electric field vector oriented along the narrow dimension of the drop is attenuated less than one oriented along the wide dimension. This changes the polarization state of the wave as it passes through the rain medium and thus gives rise to a component which is cross polarized with respect to the input polarization state. A new model for computing the forward scattered electric field intensity from a rain filled space is reported. It involves summing the scattered radiation from each raindrop to obtain the total electric field intensity at the receiver location. Following some unique simplifications, the summation process is easily carried out by a computer.
Dissert. Abstr.

N74-13842 Pennsylvania State Univ., University Park.
STATISTICAL PROPERTIES OF MICROWAVE SOLAR RADIO EVENTS Ph.D. Thesis
Frederick Lewellyn Wefer 1973 303 p
Avail: Univ. Microfilms Order No. 73-24049

A statistical study is made of 5480 microwave solar radio events observed at radio frequencies of 10.7 GHz, 2.70 GHz and 960 MHz. It is shown that as the general solar activity increased, a larger proportion of the events at each frequency were secondary events. The rates of occurrence of all of the event types increased as the Zurich smoothed sunspot number increased. The distributions of all the available morphological parameters for each type of event are presented. and variations

with radio frequency are shown. Where the samples are large enough, variations with the general solar activity are also investigated. Dissert. Abstr.

N74-13843*# Southeastern Massachusetts Univ., North Dartmouth.
NONLINEAR ANALYSIS OF PHASED-LOCKED LOOPS WITH RAPIDLY VARYING PHASE
Chi-Hau Chen and Maisie Fan 2 Oct. 1973 43 p refs
(Grant NGR-22-031-002)
(NASA-CR-132887; EE-73-6) Avail: NTIS HC $4.25 CSCL 09E

The performance of command and telemetry systems, useful in deep-space communications, is frequently affected by the radio-frequency phase error which is introduced at the point of reception by means of the carrier tracking loop. In low data rate communications, this phase error may vary rapidly over the duration of the signaling interval. In this paper such phase variation is characterized by a sinusoidal input phase, K sin (omega sub o t+, pi/6), which models a typical phase variation in communication over turbulent media. Conditions for synchronization stability and the acquisition behavior are examined by detailed computer study of the phase-plane trajectories for the second and third-order loops with perfect integrator. It is demonstrated that for the phase variation considered the third-order loop has no real advantage over the second-order loop. Finally, it is shown that nonzero initial conditions may result in large steady-state phase error. Author

N74-13844# Australian Post Office Research Labs., Melbourne.
MULTIPLE-ACCESS TELEPHONY FOR AN AUSTRALIAN SATELLITE SYSTEM
J. M. Balderston Jun. 1973 37 p refs
(Rept-6811) Avail: NTIS HC $4.00

Multiple access telephony is a service intermediate between high capacity trunk telephony and single channel remote subscribers telephony which can extend the coverage and flexibility of a communications satellite system. Topics covered include descriptions of possible multiplexing, modulation, and multiple access methods, channel capacities for a number of systems, interference and network control considerations, and relative costs. It is concluded that the most desirable system could be conventional FDM/FM/FDMA, a TDMA system, or single channel per carrier FM or PCM. Author

N74-13845# National Aviation Facilities Experimental Center, Atlantic City, N.J.
ACCURACY TEST OF NAFEC INSTRUMENTATION RADAR Final Report, May - Jul. 1966
Vincent J. Luciani Jan. 1974 21 p
(FAA-NA-73-94) Avail: NTIS HC $3.25

The slant range and azimuth accuracy capability of the National Aviation Facilities Experimental Center's extended area instrumentation radar was conducted using photographic technique for establishing reference position. Accuracies, compensated for propagation effects, were found to be 48 feet in slant range, and 0.012 degrees in azimuth. Author

N74-13846# Advisory Group for Aerospace Research and Development, Paris (France).
PROPAGATION EFFECTS OF FREQUENCY SHARING
I. Ranzi, ed. (Ist. Super. P.T. Viale Trastevere) Sep. 1973 307 p In ENGLISH; partly in FRENCH Presented at the Specialists Meeting of the Electromagnetic Wave Propagation Panel, Rome, 7-11 May 1973
(AGARD-CP-127) Avail: NTIS HC $17.50

Problems related to the propagation effects which may influence the feasibility of frequency sharing among various telecommunication services are considered. For individual titles, see N74-13847 through N74-13871.

N74-13847 Radio and Space Research Station, Slough (England).
INTRODUCTORY SURVEY TO SESSION 1. PROPAGATION OVER IRREGULAR TERRAIN
R. W. Meadows *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 2 p (For availability see N74-13846 05-07)

A survey is presented on the general problem of predicting wave propagation loss over irregular terrain and the production of unwanted high signal levels at a distance. Mathematical predictions of terrain screening effects and field strength for a ground path of a given profile are considered in suitable siting selections for communication terminals. G.G.

N74-13848 British Broadcasting Corp., Kingswood (England).
THE PROPAGATION OF ELECTROMAGNETIC WAVES OVER IRREGULAR TERRAIN
R. W. King and H. Page *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 20 p refs Prepared in cooperation with Imp. Coll. of Sci. and Technol. (For availability see N74-13846 05-07)

A method is proposed for calculating the field strength of radio frequency signals propagated over irregular terrain; a typical application is to estimate the diffraction loss in the shadow of hills, or similar obstacles, for terrestrial transmitters working on frequencies between 50 and 1000 MHz. Approximations are made in the theoretical treatment in order to make the method sufficiently simple to be used in the planning of practical systems. The ground irregularities are regarded as approximating to one or other of a set of standard obstacles; the extent of the local irregularity which determines the effective obstacle shape is determined, thus enabling irregular ground to be approximated to a series of the standardized obstacles. The diffraction loss is deduced first for single obstacles and then for multiple obstacles; the obstacles are assumed to be smooth, but the effect of roughness is discussed. The theoretical results are compared with measurements using small scale models and also with practical field surveys. Author

N74-13849 Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
ROLE OF ATMOSPHERIC DUCTS IN THE PHENOMENA OF INTERFERENCE OVER LARGE DISTANCES [ROLE DES CONDUITS ATMOSPHERIQUES DANS LES PHENOMENES DE BROUILLAGE A GRANDE DISTANCE]
P. Misme *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 12 p refs In FRENCH (For availability see N74-13846 05-07)

A theory was developed to serve as a guide to propagation interference caused by atmospheric ducts. Data cover leakage coefficients, propagation curves, and the influence of terrain and water on propagation. Transl. by E.H.W.

N74-13850 Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
EFFECT OF TERRAIN SCREENING ON THE DIFFERENT MECHANISMS OF PROPAGATION [EFFET D'ECRAN DU TERRAIN POUR LES DIFFERENTS MECANISMES DE PROPAGATION]
L. Boithias *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 9 p refs In FRENCH (For availability see N74-13846 05-07)

The influence of various terrain screening techniques on propagation mechanisms is investigated. Data are included on diffraction by ridges, spherical diffraction, tropospheric diffusion, precipitation diffusion, refraction, and reflection. Particular attention was given to the role played by local relief.
Transl. by E.H.W.

N74-13851 Imperial Coll. of Science and Technology, London (England).
RADIO WAVE DIFFRACTION DUE TO A MOUNTAIN OF VOLCANIC ORIGIN
W. G. Burrows and J. D. Ridler *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 26 p refs (For availability see N74-13846 05-07)

A simple modelling technique is employed to examine the field distribution in the shadow of a mountain obstacle which is approximately conical in overall shape and typical of one of volcanic origin. The experimental procedure includes measurements of the field distributions in the shadows of a right circular cone representing the ideal mountain shape, and a right circular cone whose surface contours are modified to give an approximate scale model representation of an actual mountain. Distributions are also obtained for the field intensities in the shadow regions

of these obstacles when the air over their upper surfaces supports a temperature gradient which is subjected to the additional influence of an air stream. Results are given to indicate, by comparison with those obtained for a simple knife-edge representing the mountain, the magnitudes of the errors that might arise in the calculation of the obstacle loss or gain for a radio path when no account is taken of the obstacle shape and the state of the atmospheric medium above its surface. Author

N74-13852 Research Inst. of National Defence, Stockholm (Sweden).
VARIATIONS IN DIFFRACTION LOSS DUE TO TROPOSPHERIC EFFECTS AT FREQUENCIES BETWEEN 180 MHz AND 10 GHz IN HILLY TERRAIN
Ake Blomquist, Folke Eklund, and Lennart Nilsson *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 13 p refs (For availability see N74-13846 05-07)

The variations in time of the diffraction loss at the frequencies 180, 2300 and 9350 MHz have been studied over a 30 km path in irregular terrain typical for central Sweden during a period of about 3 years. In addition to these measurements, short term field strength recordings have been carried out at 44, 66, 88 and 1000 MHz. The angular distance of the path was 0.38 deg. The diffraction loss over the path was normally quite constant at the frequencies studied. The stable signal had, however, a superimposed component of very small amplitude with rapid fading probably due to turbulent scatter. Mainly at night during summer it occured that the screening effect was considerably reduced due to propagation disturbances caused by layered tropospheric structures. Two different types of signal can then be distinguished: rapid amplitude variations of irregular character with a somewhat higher average level compared to the stable signal mentioned above, and rather slow amplitude variations with deep fading minima of regular character and with a much higher average level than the stable one. Statistics of the variations in diffraction loss are presented and possible propagation mechanisms causing the variations are discussed.
Author

N74-13853 Centro Radioelettrico Sperimentale G. Marconi, Rome (Italy).
TROPOSPHERIC INFLUENCE ON THE SCREENING EFFECT DUE TO A MOUNTAIN RIDGE, ON 3 GHz
I. Ranzi and P. Giorgi *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 3 p (For availability see N74-13846 05-07)

During one year, measurements have been carried out of the basic propagation loss at 3.04 GHz in a 56.2 km path, comprising a mountain flat top of 933 m of height. The annual median value of the basic propagation loss resulted to be 220.7 db; the median loss due to obstacle was 83.7 db, that is more than 45 db higher than the loss due to a knife edge obstacle. The statistical analysis of the received signal showed the presence of a Rayleigh component and of a slow fading component; the monthly median value of the last component was about 10 db lower than the Rayleigh component on January and 3 db lower on June. As the monthly median signal amplitude increased by about 14 db from January to June, it seems that an important contribution derived from partial reflections from relatively stable layers above the mountain top. Author

N74-13854 Computer Sciences Corp., Falls Church, Va.
PRECIPITATION MODELS FROM RADAR AND RAINFALL DATA
Frederick J. Altman *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 18 p refs (For availability see N74-13846 05-07)

To guide estimates of attenuation and scattering of radio waves, a model for spatial distributions of reflectivity in storm cells has been fitted to digitized radar data. The model assumes ellipses for contours of constant reflectivity factor, Z, with constant orientation and eccentricity within a horizontal cell cross section at a given time and evaluation. The centers of the ellipses are assumed uniformly spaced on a straight line, with areas linearly related to log Z. Except for cell tops and bottoms, and for splitting, the cross sections were similar at different heights, especially for the highest reflectivities. In an attempt to relate reflectivity aloft to surface rainfall, similar radar data, and hourly rainfall from 30 stations within a circular area about 200 km in radius were used to study precipitation distributions in time and space. Both types of data were found to provide similar distributions, with useful correlations among several parameters.
Author

N74-13855 Deutsche Bundespost, Darmstadt (West Germany).
MEASUREMENTS OF PRECIPITATION SCATTER AT 11.6 GHz
F. Dintelmann and F. Ruecker *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 6 p refs (For availability see N74-13846 05-07)

A bistatical experimental study of precipitation scatter at 11.6 GHz is proposed that uses simultaneously steerable transmitting and receiving antennas separated by a large area. This allows for scatter observations on rainshowers crossing the radio link and to determine the structure and dynamics of rain cells. G.G.

N74-13856 Office of Telecommunications, Boulder, Colo.
ESTIMATING ATTENUATION, SCINTILLATION, AND SCATTERING DUE TO RAINFALL FOR SATELLITE/GROUND SYSTEMS
H. T. Dougherty and E. J. Dutton *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 13 p refs (For availability see N74-13846 05-07)

A state-of-the-art engineering model is described for estimating the expected performance degradation of satellite-to-ground microwave systems because of atmospheric gases, clouds, and rain. The model incorporates an allowance for the spatial structure of atmospheric gases, clouds and rain as well as local and regional rainfall statistics. The estimates are in terms of attenuation and scintillation as well as the volume reflectivity which contributes to co-channel interference. Composite predictions are given for 15 GHz, as representative of microwave signals for small percentages of an average year. This prediction is a function of location and the angle-of-arrival at ground stations on the central east coast of the U. S. A. Author

N74-13857 Technische Hogeschool, Eindhoven (Netherlands).
INTRODUCTORY SURVEY TO SESSION 3. CONTROL OF ANTENNAE SIDE LOBES
B. VanDijl *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 9 p refs (For availability see N74-13846 05-07)

After a short discussion of the importance of side lobes for communication networks and of their physical background, the emphasis is laid on the development of insight in the possibilities of influencing near angle side lobes. The effect of blocking of the aperture by obstructions is discussed in general terms and an estimate is made of the magnitude of the blocking effect.
Author

N74-13858 Technische Hogeschool, Eindhoven (Netherlands).
SOME ASPECTS OF NEAR AND FAR ANGLE SIDELOBES IN DOUBLE-REFLECTOR ANTENNAS
J. Dijk and E. J. Maanders *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 16 p refs (For availability see N74-13846 05-07)

Analysis and synthesis of the directive gain pattern of reflector antennas, especially Cassegrain antennas are considered. After a short introduction into the geometry of classical and shaped Cassegrain antennas, scalar aperture theory is used in a method to calculate the main lobe and near angle sidelobes of a blocked aperture. Scalar aperture theory is also used to calculate the sidelobes of mismatched shaped Cassegrain antennas. The second part of the paper deals with far angle sidelobes. An example of Kirchhoff integration is shown and finally it is demonstrated that by shaping main and subreflector power scattered by subreflector and supports may be transported in the correct phase to the aperture, decreasing far angle scattering. Author

N74-13859 Societa Italiana per l'Esercizio Telefonico, Rome (Italy).
THE RADIATION DIAGRAMS OF ANTENNAS USED IN TERRESTRIAL MICROWAVE LINE-OF-SIGHT SYSTEMS
C. Colavito and G. Masone *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 8 p refs (For availability see N74-13846 05-07)

Measurements carried out on parabolic disk antennas used

in terrestrial microwave line-of-sight relay systems are reported. These systems are allocated in the 7 GHz frequency band which is shared between terrestrial and satellite fixed services. The measurements have been performed in a field where the free space propagation conditions were approximated, as well as in the real installation conditions. In the two above mentioned situations, the smoothed envelopes of the radiation diagrams have been obtained for different types of antennas. Some conclusive remarks are made concerning the characteristics of the terrestrial radio relay antennas to be considered in the interference analyses. Author

N74-13860 Louvain Univ. (Belgium).
SYNTHESIS OF APERTURE DISTRIBUTIONS FOR OPTIMUM GAIN WITH NOISE AND INTERFERENCE REJECTION
M. Safak and P. Delogne *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 12 p refs (For availability see N74-13846 05-07)

Synthesis of the aperture distributions yielding the best rejection of noise or interfering sources located in a given region of the radiation pattern is examined. Previous methods are reviewed. It is shown that they are not always optimum or require too much computer time, or yield too complicated distributions for practical purposes. The proposed method permits the optimization of the gain-to-temperature ratio for an arbitrary distribution of noise and interfering sources, it avoids superdirectivity and even unnecessary sophistication of the distribution. Results are presented for linear and circular apertures with symmetrical distributions. Author

N74-13861 Fondazione Ugo Bordoni, Rome (Italy).
INTRODUCTORY SURVEY TO SESSION 4. PROPAGATION DATA FOR INTERFERENCE PROBABILITY DETERMINATIONS
F. Fedi *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 5 p refs (For availability see N74-13846 05-07)

Varied aspects of tropospheric propagation and interference probability calculation methods are considered for a wide range of frequencies. Wave scattering, reflecting and ducting phenomena are studied as well as attenuation due to the atmosphere and to precipitations both for terrestrial and satellite radio links. G.G.

N74-13862 SIGMA Association, Hamburg (West Germany).
DUCTING PROPERTIES OF ELEVATED LAYERS
C. Fengler *In* AGARD Propagation Effects of Freq. Sharing Sep. 1963 9 p refs (For availability see N74-13846 05-07)

Field strength observed at VHF and UHF transhorizon paths exceeds considerably the average value in 10% of time. These 10% values are due to the influence of elevated layers if ground based layers are absent. In the referred observations at individual paths the obvious explanation by reflection processes fails because of ray geometry. Ducting mechanisms have to be assumed. The possibilities of ducting are generally considered in point of view of ray theory, wave optics, and path geometry for various tropospheric profiles. Author

N74-13863 Research Inst. of National Defence, Stockholm (Sweden).
THE OCCURRENCE OF VERY HIGH FIELD STRENGTHS AT BEYOND THE HORIZON PROPAGATION OVER SEA IN THE FREQUENCY RANGE 60 - 5000 MHz
Sture Wickerts and Lennart Nilsson *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 15 p refs (For availability see N74-13846 05-07)

The occurrence of enhanced fields has been studied over a sea path of 160 km at the frequencies 170 MHz, 460 MHz and 5000 MHz. For short periods also 60 MHz was used. Long term measurements of field strength have been performed since 1968, which includes some period of meteorological measurement. For these measurements an airborne refractometer, captive balloon sondes and an acoustic sounder were used. The received signals can be classified by the following three types: Standard atmosphere signal (tropospheric scatter signal), unstable high signal caused by reflection in elevated tropospheric layers, and stable high signal caused by ducting. The fact that the signals at different frequencies are only occasionally correlated indicates that the propagation is governed by different mechanisms in different parts of the frequency spectrum. A case study of propagation under various tropospheric conditions and the long term statistics of the different signal types are given. Author

N74-13864 Communications Research Centre, Ottawa (Ontario).
INTERFERENCE MEASUREMENTS AT 15.7 GHz OVER A LONG TRANSHORIZON PATH
R. L. Olsen and U. H. W. Lammers *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 15 p refs Prepared in cooperation with AFCRL, H. G. Hanscom Field, Mass. (For availability see N74-13846 05-07)

Experiments are being carried out to obtain transmission loss statistics for 500 km overland path at 15.7 GHz. The interference situation simulated is that of a terrestrial transmitter interfering into the earth terminal receiver of a space communications system along the great circle path between them or at off path angles close to the great circle azimuth. The initial results of measurements over a six month period indicate that, for this path, the empirical method underestimates the transmission loss not exceeded for small percentages of the time by an amount which increases with the elevation angle of the earth station antenna. Additional analysis is also being carried out to determine the relative occurrences of turbulent scattering, hydrometer scatter (including cloud scatter), and ducting, and to separate the data accordingly. Author

N74-13865 GEC-Marconi Electronics Ltd., Chelmsford (England).
TROPOSCATTER PROPAGATION IN AN EQUATORIAL CLIMATE
R. Larson *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 9 p refs Sponsored by the Min. of Defence (For availability see N74-13846 05-07)

A troposcatter link between Singapore and Penang was operated for almost two years. During this time continuous analogue recordings of received signal strength were made, and meteorological measurements were also made at both ends of the link. The radiometeorology proved to be very stable, and was an excellent example of equatorial type climate. The measured median signal level was very close to the predicted value, and also the hourly median signal levels followed a log-normal distribution with great fidelity, even to extreme percentage levels, both high and low. Consideration of the available data led to the conclusion that there was no evidence of any ducting at all, a pure scatter signal being received throughout. Fast fading records indicated that even at the highest signal levels a Rayleigh fading signal was present, and the log-normal and Rayleigh distributions have been combined to produce an overall distribution of instantaneous signal level. Author

N74-13866 Radio and Space Research Station, Slough (England).
STATISTICS OF HIGH-LEVEL BEYOND-HORIZON SIGNALS AT 2.2 GHz AND 2.6 GHz, AND MEASUREMENTS OF THE VARIATION OF THE ARRIVAL-ANGLE-STRUCTURE
M. P. M. Hall *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 10 p refs (For availability see N74-13846 05-07)

Continuous recordings of field strength were made simultaneously over two 300 km troposcatter paths, one over land at 2.6 GHz and the other partly over sea at 2.2 GHz. The recordings were made on 1.2 m diameter antennae at Chilbolton (near Winchester, UK). Periodically, the 25 m diameter steerable antenna was used to scan across the paths in bearing and elevation to determine the angular distribution of the arriving energy. An analysis is presented of the high signal strengths exceeded for small percentages of the time, of the relative duration of these enhancement periods, and of the changes in angular spread which occurred as the high signals built up and died away. Results from an analysis of the cross correlation of the outputs from large and small antennas are presented, in order to determine if phase-cancellation of unwanted interference may be feasible during periods when interference signals on troposcatter paths become unacceptable high. Author

N74-13867 Scripps Institution of Oceanography, La Jolla, Calif.

HF MEASUREMENTS OF OCEAN-WAVE DIRECTIONAL SPECTRA

Robert H. Stewart, Calvin Teague, Joseph W. Joy, and G. Leonard Tyler *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 7 p refs Prepared in cooperation with Stanford Univ. (For availability see N74-13846 05-07)

(Contract N00014-69-A-0200-6012)

Bragg scattered HF radio waves were used to measure the directional spectrum of 0.14 Hz ocean waves during a time when they were in equilibrium with a constant and spatially homogeneous wind field. The radio data consisted of monostatic measurements of LORAN A radio signals backscattered from the ocean. These signals are pulsed, coherent, and vertically polarized, and are resonantly scattered only by 0.14 Hz ocean waves moving radially toward or away from the transmitter receiver point. The direction of arrival of the radio waves, and thus the directional distribution of the ocean wave energy, was determined by synthesizing a directional antenna having a maximum beamwidth of 5-10 deg. The synthesis was done by moving the receiver along two nearly orthogonal paths using the runway and taxiways of the island. The right-left ambiguity in the synthesized antenna was resolved by using a switched cardioid antenna which looked alternately to the right and the left as the basic receiving element. The angular dependence of the ocean wave directional spectrum is presented as a function of wind speed. Author

N74-13868 Hamburg Univ. (West Germany). Inst. fuer Radiometeorologie und Maritime Meteorologie.

EXPLANATION OF VERY LOW FIELD STRENGTH LEVELS ON LINE-OF-SIGHT PATHS OVER SEA

H. W. Fruechtenicht *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 12 p refs (For availability see N74-13846 05-07)

Line-of-sight propagation over sea may be treated by ray tracing. The method is applied to linear profiles and duct profiles of the refractive index. The model calculation show that the receiving field passes through a number of interferences lobes if the duct thickness is increased. This effect is verified by experiments. Furthermore the theoretical considerations yield that the sea evaporation duct causes a certain antenna height, where the receiving field may vanish. With increasing duct thickness, this special receiving point is shifted upwards. Vertical polarization puts it on a lower level than horizontal polarization. Moreover, with increasing duct thickness it is shifted upwards more slowly for vertical polarization than for horizontal polarization. Author

N74-13869 Servico de Telecomunicacoes Militares, Lisbon (Portugal).

ANALYSIS OF 11 GHz BAND PROPAGATION IN PORTUGAL

J. A. Saraiva-Mendes *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 8 p refs (For availability see N74-13846 05-07)

Supplemental attenuation due to rain at 11 GHz, on paths 20 km long, in different places of Portugal is estimated. The cumulative distributions of clock hourly rain rates for Lisbon, Oporto and Coimbra are calculated and compared with those obtained directly from climatic data, using the method proposed by Russak and Easley. Then, using the methods proposed by Quarta and by Boithias et al the cumulative distributions of instantaneous attenuation due to rain are also calculated for Lisbon, Oporto and Coimbra. The results obtained with both methods are compared and discussed. It seems that the method proposed by Boithias et al, cannot be widely used in Portugal. However, the reduction coefficients proposed by Boithias et al in order to obtain the equivalent rain rate along a path, lead to distributions similar to those obtained with with the method proposed by Quarta. The estimated supplemental attenuation in a path 20 km long at 11 GHz, is about 35 db for 0.001% of the year, and for paths orthogonal to the dominant winds.

Author

N74-13870 Department of Transportation, Cambridge, Mass.

MEASUREMENT OF ATMOSPHERIC ATTENUATION AT THE FREQUENCIES OF 15, 19, AND 34 GHz

George G. Haroules, Wilfred E. Brown, and Gregory J. Bishop *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 14 p refs (For availability see N74-13846 05-07)

There are two methods of determining atmospheric attenuation without having to use a space vehicle. In the first, attenuation may be measured by observing the extinction of an exoatmospheric source as a function of the zenith angle. The second method depends upon the measurement of atmospheric emission from which the corresponding attenuation is calculated using an assumed atmospheric mean temperature. The magnitude of atmospheric attenuation and the relative time interval of its occurrence at millimeter wavelengths must include consideration of the elevation angle of observation. Knowledge of the percentage of time during which relatively high values of attenuation are observed is irrelevant without consideration of the elevation angle of observation at the time of occurrence. Attenuation statistics resulting from a twelve month observation program are presented. The sun is used as a source of microwave radiation. The dynamic range of atmospheric attenuation measurement capability is in excess of 30 db. Author

N74-13871 Army Satellite Communications Agency, Fort Monmouth, N.J.

THE INTERRELATION OF PROPAGATION EFFECTS AND DESIGN FACTORS FOR FIXED SERVICE COMMUNICATIONS SATELLITE SYSTEMS

Billy J. Fansler and S. M. Segner *In* AGARD Propagation Effects of Freq. Sharing Sep. 1973 11 p refs Prepared in cooperation with ECOM, Ft. Monmouth, N. J. (For availability see N74-13846 05-07)

The problems of frequency sharing between multichannel transmission using satellites and multichannel transmission using radio relay are reviewed. Two cases of potential interference involve determination of coordination distance based on normalized basic transmission in the absence and in the presence of precipitation. One case is for the earth station received signal being interfered with by terrestrial station transmitters. The second is for earth station transmitted signal interfering with terrestrial station receivers. Taking advantage of a newly written computer program, the effects of varying propagation factors, radio climatic regions, rain climatic zones and interference duration is investigated. Author

N74-13872# Syracuse Univ., N.Y.

ANTENNA PATTERN DISTORTION COMPUTER PROGRAM

Jose Perini and Kazuhiro Hirasawa Aug. 1973 44 p

(Contract F30602-72-C-0360)

(AD-767906; RADC-TR-73-230) Avail: NTIS CSCL 09/5

Presently, when a new communication facility is designed, there is no simple way that the project engineer can predict the interaction between the many antennas that will be present in the facility. The available rules of thumb are too crude and do not really give any detailed information on the antenna pattern distortion or mutual coupling effects. Recent developments in the area of computer aided design of antennas allowed the development of a computer program that can perform an accurate analysis of the most common antenna installations with far more detail than has been possible. The description and usage of this program is the subject of the report. Author (GRA)

N74-13873# Illinois Univ., Urbana. Radiolocation Research Lab.

WAVE POLARIZATION MEASUREMENTS IN HF SHORT RANGE RADIO LOCATION Technical Report No. 45

William M. Glenn, Jr. and Albert D. Bailey Aug. 1973 68 p refs

(Contract N00014-67-A-0305-0002)

(AD-768025; RRL-Pub-436; UILU-ENG-73-2555; TR-45) Avail: NTIS CSCL 17/3

Wave polarization measurements in HF radiolocation are often necessary but not sufficient per se for complete solution of the radiolocation problem. There are cases where the radio signals arrive via steeply downcoming paths. In these latter cases polarization measurements alone may be sufficient to fix the most probable range of the signal source. The report discusses the design, construction and testing of a radio polarimeter system for use in the neighborhood of 5 MHz. In addition to the three-orthogonal-dipole-antenna element array, it uses quadrature hybrids, a matched in gain and phase triple-channel radio receiver

and associated logic to separate the two characteristic polarizations. The systems are shown to be successful when working under the conditions and constraints of the design. Gravity waves and traveling disturbances in the ionosphere will produce additional effects which have not been considered here.
Author (GRA)

N74-13874# Naval Electronics Lab. Center, San Diego, Calif.
A METHOD OF DETECTING SIGNIFICANT SOURCES OF INTERMODULATION INTERFERENCE Research and Development Report, 12 Jul. - 20 Aug. 1973
W. M. Chase, J. W. Rockway, and G. C. Salisbury 20 Aug. 1973 13 p refs
(AD-767929; NELC-TR-1883) Avail: NTIS CSCL 17/2

An accurate knowledge of lowest orders is shown to be important for locating significant sources of intermodulation interference signals. A practical, reliable method is presented for calculating the lowest order occurring on the frequency of any intermodulation signal observed to be strong enough to threaten low-error-rate reception. A hypothetical example involving two local transmit frequencies is described. The method is found to represent a major extension in applicability and ease of use over previous calculations, which were awkward and unsatisfactory for field use. Author (GRA)

N74-13875# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.
NONLINEAR WAVE PROPAGATION Final Report
R. S. Rivlin Sep. 1973 18 p refs
(Contract DAAD05-69-C-0053; Proj. Themis)
(AD-768208; BRL-CR-120) Avail: NTIS CSCL 20/11

The report is a summary of the work accomplished under THEMIS project no. 65, Non-Linear Wave Propagation. In addition it lists all technical reports, and the corresponding papers published in the course of the project. Author (GRA)

N74-13876# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE COMPOSITION OF REPORTED HOW-MALFUNCTIONED CODES Final Report
Nilss M. Aume May 1973 38 p refs
(AF Proj. 7184)
(AD-767200; AMRL-TR-72-89) Avail: NTIS CSCL 15/5

A sample of over 61,000 maintenance reports was analyzed with respect to frequency of use of the how-malfunctioned codes. Approximately negative-exponential distributions of reported code frequencies were found, with the single most frequently used code accounting for 28.8% of all reports, the two most frequent codes accounting for 38.4%, and five codes accounting for 50.2%. 50% of the work centers used nine or fewer codes. The results of this study lend support to the desirability of substituting a mnemonic code for the current how-malfunctioned coding system. (Modified author abstract) GRA

N74-13877# Sperry Rand Corp., St. Paul, Minn. Univac Defense Systems Div.
PROSODIC AIDS TO SPEECH RECOGNITION. 3: RELATIONSHIPS BETWEEN STRESS AND PHONEMIC RECOGNITION RESULTS Semiannual Technical Report, 1 Mar. - 31 Aug. 1973
Wayne A. Lea, Mark F. Medress, and Toby E. Skinner 21 Sep. 1973 44 p refs
(Contract DAHC15-73-C-0310; ARPA Order 2010)
(AD-767392; PX-10430) Avail: NTIS CSCL 17/2

A strategy is being implemented for acoustic aspects of speech recognition, whereby prosodic features are used to detect boundaries between phrases, then stressed syllables are located within each phrase, and a partial distinctive features analysis is done within stressed syllables. Several algorithms are being investigated for locating stressed syllables in continuous speech. Preliminary experiments have shown some success in locating sibilants and determining their places of articulation. Partial distinctive features analysis on stressed vowels has been attempted. Location of stop consonants and sibilants, and sibilant place of articulation determination have been more successful in stressed syllables. Studies are being conducted on the relative success of vowel and obstruent categorizations in stressed, unstressed, and reduced syllables. These studies in segmental analysis, and companion studies in stress perception and automatic location of stressed syllables, are being conducted on 31 ARPA Sentences, but later work will be based on new speech texts now being designed. (Modified author abstract) GRA

N74-13878# National Water Lift Co., Kalamazoo, Mich.
FEASIBILITY ANALYSIS AND EVALUATION STUDY OF A REMOTELY CONTROLLED VEHICLE Final Report
J. N. Tootle 22 May 1973 296 p
(Contract DAAE07-73-C-0071)
(AD-768213; NWL-R-1659) Avail: NTIS CSCL 15/7

The report documents the feasibility studies completed on a remotely controlled vehicle conceived for an antitank search-and-destroy mission. A four-wheel drive vehicle of 64.8 inch wheelbase and 62-inch overall width, with 29-inch tires, was found necessary for the required mobility. A 25-hp gasoline engine combined with hydrostatic transmissions provided a very maneuverable prime mover. A 10-channel 1-watt UHF-FM transmitter modulated by a digital pulse control system, comprised the communication link. A head-aimed TV with a foveal/peripheral format system was required to control a TV/armmament platform. Two TV cameras and three lenses were selected to provide information to a 10-watt video system. The TV-armament platform could mount either two DRAGON or two TOW missiles and their associated trackers for the destroy requirements of the mission.
Author (GRA)

N74-13879# Aerospace Corp., San Bernardino, Calif. Reentry Systems Div.
VAN V LECK REVISITED: THE RCS (RADAR CROSS SECTION) OF THIN WIRES Technical Report, Jul. 1972 - Apr. 1973
M. T. Tavis 1 Jul. 1973 41 p refs
(Contract F04701-73-C-0074)
(AD-768336; TR-0074(4450-16)-1; SAMSO-TR-73-307) Avail: NTIS CSCL 17/9

The approximate theory of radar reflection from thin wires by Van Vleck, et. al., gives very good average radar cross section (RCS) results and good angular RCS results except end-on. In the paper, the nature of this end-on discrepancy is examined. It is found that, if the complete expressions derived by Van Vleck, et. al., are used without the approximations made to simplify calculation of the average RCS over all angles of incidence, then very accurate RCS results are predicted for nearly all angles of incidence and for all the wire length-to-wavelength ratios between 0.45 and 50. Comparisons with the numerical results of a source distribution technique (SDT) computer program and with the results due to Ufimtsev are shown. Author (GRA)

N74-13924 Societa Italiana Telecomunicazioni Siemens S.p.A., Milan (Italy).
COMPUTER DESIGN OF EQUAL RIPPLE EQUALIZATION
A. Maggi and N. Montefusco *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 8 p refs (For availability see N74-13906 05-10)

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

N74-13880*# Michigan Univ., Ann Arbor. Systems Engineering Lab.
A STRUCTURALLY ORIENTED SIMULATION SYSTEM
Zvi Aran Jul. 1973 51 p
(Grant NGR-23-005-463)
(NASA-CR-136500; SEL-TR-70) Avail: NTIS HC $4.75 CSCL 09B

The computer program SOSS (Structurally Oriented Simulation System) is designed to be used as an experimental aid in the study of reliable systems. Basically, SOSS can simulate the structure and behavior of a discrete-time, finite-state, time-invariant system at various levels of structural definition. A general description of the program is given along with its modes of

operation, command language of the basic system, future features to be incorporated in SOSS, and an example of usage. D.L.G.

N74-13881*# Michigan Univ., Ann Arbor. Systems Engineering Lab.
ON-LINE DIAGNOSIS OF SEQUENTIAL SYSTEMS
Robert J. Sundstrom Jul. 1973 72 p refs
(Grant NGR-23-005-463)
(NASA-CR-136499; SEL-TR-72) Avail: NTIS HC $5.75 CSCL 09B

A model for on-line diagnosis was investigated for discrete-time systems, and resettable sequential systems. Generalized notions of a realization are discussed along with fault tolerance and errors. Further investigation into the theory of on-line diagnosis is recommended for three levels: binary state-assigned level, logical circuit level, and the subsystem-network level. F.O.S.

N74-13882*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A REAL-TIME DIGITAL PROGRAM FOR ESTIMATING AIRCRAFT STABILITY AND CONTROL PARAMETERS FROM FLIGHT TEST DATA BY USING THE MAXIMUM LIKELIHOOD METHOD
Randall D. Grove and Stanley C. Mayhew (Electronic Assoc., Inc.) Washington Dec. 1973 132 p refs
(NASA-TM-X-2788; L-8796) Avail: NTIS HC $4.50 CSCL 09B

A computer program (Langley program C1123) has been developed for estimating aircraft stability and control parameters from flight test data. These parameters are estimated by the maximum likelihood estimation procedure implemented on a real-time digital simulation system, which uses the Control Data 6600 computer. This system allows the investigator to interact with the program in order to obtain satisfactory results. Part of this system, the control and display capabilities, is described for this program. This report also describes the computer program by presenting the program variables, subroutines, flow charts, listings, and operational features. Program usage is demonstrated with a test case using pseudo or simulated flight data. Author

N74-13883*# Texas A&I Univ., Kingsville. Dept. of Electrical Engineering.
THE CADSS DESIGN AUTOMATION SYSTEM Final Report
Ernest A. Franke [1973] 79 p refs
(Contract NAS9-9214)
(NASA-CR-134165) Avail: NTIS HC $6.00 CSCL 09B

This research was designed to implement and extend a previously defined design automation system for the design of small digital structures. A description is included of the higher level language developed to describe systems as a sequence of register transfer operations. The system simulator which is used to determine if the original description is correct is also discussed. The design automation system produces tables describing the state transistions of the system and the operation of all registers. In addition all Boolean equations specifying system operation are minimized and converted to NAND gate structures. Suggestions for further extensions to the system are also given. Author

N74-13884# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SPACE OBJECT IDENTIFICATION BY FILTERED FOURIER TRANSFORM PATTERN RECOGNITION ALGORITHM M.S. Thesis
William L. Malinski Jun. 1973 107 p refs
(AD-768347; GE/EE/73S-4) Avail: NTIS CSCL 09/2

Light intensity signals reflected from three classes of orbiting rocket bodies were analyzed using one-dimensional Fourier transforms. Low-frequency filtering in the transform domain and the Euclidean distance metric were used to classify the signals into the three classes. Using a portion of the data, linear decision boundaries were constructed by an adaptive training algorithm. It was found that the low-frequency filtered one-dimensional Fourier-transform domain gave good separation of the three classes of rocket bodies analyzed. A method of automated space object identification is proposed for non-stabilized satellites. It is suggested that the algorithm used in the study is also applicable to data collected via radar. Author (GRA)

N74-13885# Wisconsin Univ., Madison. Mathematics Research Center.
ON THE EXISTENCE OF OPTIMAL SOLUTIONS TO INTEGER AND MIXED-INTEGER PROGRAMMING PROBLEMS
R. R. Meyer Aug. 1973 22 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-767124; MRC-TSR-1351) Avail: NTIS CSCL 12/2

The purpose of the paper is to present sufficient conditions for the existence of optimal solutions to integer and mixed-integer programming problems in the absence of upper bounds on the integer variables. It is shown that (in addition to feasibility and boundedness of the objective function) in the pure integer case a sufficient condition is that all of the constraints (other than non-negativity and integrality of the variables) be equalities, and that in the mixed-integer case rationality of the constraint coefficients is sufficient. Some computational implications of these results are also given. Author (GRA)

N74-13886# Network Analysis Corp., Glen Cove, N.Y.
THE PRACTICAL IMPACT OF THE RECENT COMPUTER ADVANCES ON THE ANALYSIS AND DESIGN OF LARGE SCALE NETWORKS Semiannual Report
Howard Frank May 1973 199 p refs
(Contract DAHC15-73-C-0135; ARPA Order 2286)
(AD-767403; SAR-1) Avail: NTIS CSCL 09/2

New research results on the following major questions are reported: Growth and cost performance tradeoffs for the ARPANET, traffic sensitivity analyses with measured traffic and with possible ILLIAC IV traffic effects and ARPANET capacity expansion. Initial cost, delay, throughput and reliability analyses for a 1000 node packet switched network based on ARPANET technology. Development of efficient algorithms for location and line layout for local and regional access to Terminal Interface Processors. The development of an interactive data handling system based on an IMLAC display and distributed ARPANET computation. Study of flow control, routing and time delay and system organization for broadcast packet systems. Author (GRA)

N74-13887# General Electric Co., Schenectady, N.Y.
DESIGN, FABRICATION, AND EVALUATION OF AN ELECTRON BEAM ADDRESSABLE HIGH INFORMATION DENSITY MEMORY TUBE Quarterly Progress Report, 1 Mar. - 30 Apr. 1973
Charles Q. Lemmond Sep. 1973 22 p
(Contract DAAB07-72-C-0098; DA Proj. 1H6-31024-D-252)
(AD-767271; SRD-73-115; ECOM-0098-5-72; QPR-5) Avail: NTIS CSCL 09/2

The technical objective of this development program is the design fabrication, and evaluation of an experimental model electron beam addressable, high information density memory tube. The tube is to be a sealed-off, self-contained unit consisting of an electron source, the necessary electron optics for performing the required write and read functions, and a storage structure containing approximately 10 million elements. The program is directed towards the development of an economically feasible electron beam addressable, high information density memory tube. This operational tube shall serve as the storage element section of a block-oriented random access memory (BORAM). During this reporting period static tests were conducted on two complete memory tubes. Target studies and manufacturing improvements continue. Debugging and testing of the General Electric's memory test system continues. Final debugging will require a complete, operable memory tube to test the read-out electronics. GRA

N74-13888# Naval Postgraduate School, Monterey, Calif.
A CALCULATOR OPTION FOR THE TEKTRONIX 4010 COMPUTER GRAPHICS TERMINAL
Robert William Cherry Jun. 1973 82 p refs
(AD-767669) Avail: NTIS CSCL 09/2

Recent advances in Metal-Oxide-Semiconductor/Large-Scale-Integration (MOS/LSI) circuits have made large amounts of computational capability available in small packages. One such MOS/LSI circuit, a business-format, four-function calculator, is

used to provide a fixed-function form of intelligence in the Tektronix 4010 Computer Display Terminal. Discussion of important circuit design concepts from preliminary considerations to final testing and results is presented. Sample calculations and instructions for calculator operation are given as appendices. Author (GRA)

N74-14612* Computer Software Management and Information Center, Athens, Ga.
NASTRAN DISTRIBUTION THROUGH COSMIC
Margaret K. Park *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 569-571 refs (For availability see N74-14586 05-32)
CSCL 09B

N74-14618* Computer Sciences Corp., El Segundo, Calif.
IMPLEMENTATION EXPERIENCES OF NASTRAN ON CDC CYBER 74 SCOPE 3.4 OPERATING SYSTEM
James Chi-Dian Go and Ronald G. Hill (Westinghouse Hanford Co.) *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 627-631 (For availability see N74-14586 05-32)
CSCL 09B

N74-14619* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD FOR TRANSFERRING NASTRAN DATA BETWEEN DISSIMILAR COMPUTERS
James L. Rogers, Jr. *In its* NASTRAN: Users' Experiences Sep. 1973 p 633-639 ref (For availability see N74-14586 05-32)
CSCL 09B

N74-14620* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INTERACTIVE NASTRAN PREPROCESSOR
Willianna W. Smith *In its* NASTRAN: Users' Experiences Sep. 1973 p 641-659 refs (For availability see N74-14586 05-32)
CSCL 09B

N74-14621* United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft.
NASTRAN DATA GENERATION OF HELICOPTER FUSELAGES USING INTERACTIVE GRAPHICS
J. B. Sainsbury-Carter and John H. Conaway *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 661-678 refs (For availability see N74-14586 05-32)
CSCL 09B

N74-14623* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SIMPLIFIED MODAL PLOTTING TECHNIQUE FOR THE REPRESENTATION OF COMPLEX STRUCTURAL MODELS
Stuart L. Hanlein *In its* NASTRAN: Users Experiences Sep. 1973 p 697-705 (For availability see N74-14586 05-32)
CSCL 09B

N74-14624* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASTRAN POSTPROCESSOR PROGRAM FOR TRANSIENT RESPONSE TO INPUT ACCELERATIONS
Robert T. Wingate, Thomas C. Jones, and Maria V. Stephens *In its* NASTRAN: Users' Experiences Sep. 1973 p 707-734 refs (For availability see N74-14586 05-32)
CSCL 09B

N74-13908 Computer Aided Design Centre, Cambridge (England).
ECONOMICS OF CAD: A NEW APPROACH
A. I. Llewelyn and G. C. Freeman *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 10 p refs (For availability see N74-13906 05-10)

N74-13929 Bell-Northern Research Ltd., Ottawa (Ontario).
AN EVOLVING, OPERATIONAL COMPUTER AIDED DESIGN SYSTEM
G. Scott, D. L. Williams, and L. C. Beaumont *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 12 p refs (For availability see N74-13906 05-10)

N74-13930 Brunel Univ., Uxbridge (England).
SPECIFICATION AND DESIGN LANGUAGES FOR LOGIC SYSTEMS
Douglas Lewin *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

N74-13931* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE NASA COMPUTER AIDED DESIGN AND TEST SYSTEM
J. M. Gould and K. Juergensen *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 13 p refs (For availability see N74-13906 05-10)

N74-13932 Societe Europeenne de Semiconducteurs et de Microelectronique, Paris (France).
SIGMA: AN INTEGRATED SYSTEM OF COMPUTER AIDED COMPLEX CIRCUIT DESIGNS [SIGMA: UN SYSTEME INTEGRE DE PROGRAMMES DE CONCEPTION ASSISTEE DES CIRCUITS COMPLEXES]
J. P. Lusinchi *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 25 p refs In FRENCH (For availability see N74-13906 05-10)

N74-13933 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
A COMPUTER AIDED DESIGN SYSTEM FOR LARGE SCALE INTEGRATED DIGITAL NETWORKS
R. G. Hamer and C. S. Meyer *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

N74-13934 REDAC Software, Ltd., Tewkesbury (England).
COMPUTER AIDED DESIGN OF MULTILAYER PRINTED CIRCUIT BOARDS
W. E. Hillier *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 14 p refs (For availability see N74-13906 05-10)

N74-14516* Arizona Univ., Tucson.
A REAL-TIME COMPUTER FOR MONITORING A RAPID-SCANNING FOURIER SPECTROMETER
Guy Michel *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p refs Repr. from Appl. Opt., v. 11, Nov. 1972 p 2671-2674 (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 09B

N74-14674 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
COMPUTER CENTERS FOR PROCESSING SCIENTIFIC AEROSPACE DATA [RECHENZENTREN]
In its DFVLR Annual Review, 1972 1972 p 351-381 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N74-13889 Pennsylvania State Univ., University Park.
A STUDY OF CURRENT-POLARIZATION RELATIONS OF FLOODED POROUS ELECTRODES Ph.D. Thesis
Badr Eldean Ghazy Ateya 1972 177 p
Avail: Univ. Microfilms Order No. 73-21257

Porous electrodes, particularly the flow-through variety, have great advantages for use in fuel cells and for electrochemical syntheses, chiefly because of the high mass transport rates possible. A comprehensive mathematical model was set up in a

form susceptible to experimental test, and in particular to include effect of mass transfer by axial diffusion, which has previously been neglected. Models applicable to both reversible and irreversible systems were desired with either frontal or rear reactant supply, and to the case in which reaction proceeds by two successive steps. A corresponding model applicable to flooded diffusion electrodes was also needed. The range of validity of the models was determined by means of computed (numerical) solutions to the equations as well as by experiment. It is concluded that under most conditions the models developed provide valid methods of assessing the behavior of porous flow-through electrodes, and of designing systems for their practical use.
Dissert. Abstr.

N74-13890 California Univ., Los Angeles.
HIGH FREQUENCY TRANSISTOR POWER AMPLIFIERS Ph.D. Thesis
Lonnie Allen Wilson 1973 219 p
Avail: Univ. Microfilms Order No. 73-23424

A new high frequency transistor power amplifier design technique is presented. The transistor power amplifier is composed of the following fundamental building blocks: (1) Load; (2) output network; (3) dc source; (4) transistor; (5) input network; (6) drive source. The theoretical and practical design considerations are discussed in detail for each building block. The theoretical design considerations included a complete functional description and general design equations for the transistor power amplifier. The practical design considerations transform the general theoretical design considerations into a complete transistor power amplifier design technique. A complete set of design equations are given. Dissert. Abstr.

N74-13891 Michigan Univ., Ann Arbor.
CHARACTERISTICS OF IMPATT DIODE REFLECTION AMPLIFIERS Ph.D. Thesis
Richard William Laton 1973 190 p
Avail: Univ. Microfilms Order No. 73-24616

The gain, stability, power saturation and bandwidth properties of microwave reflection amplifiers which employ IMPATT diodes as the active element are studied, together with the dependence of all these properties upon device material, doping profile and operating conditions. A model is developed which makes use of steady state admittance data for the active device and its load to calculate stable reflection gain as the input power level and frequency are varied. The model is then exploited to predict the nonlinear performance of such amplifiers utilizing admittance data appropriate to several IMPATT device profiles in both p- and n-type silicon and gallium arsenide at several bias current densities and temperatures, and experimental evidence is presented which demonstrates the validity of the model. In addition, other experimental results are provided which demonstrate the effects of the presence of signals at harmonically related frequencies on both stable reflection amplifiers and on oscillators. Dissert. Abstr.

N74-13892# Technische Universitaet, Brunswick (West Germany).
FREQUENCY CONVERTER WITH METAL INSULATED SEMICONDUCTOR VARACTORS Ph.D. Thesis [FREQUENZUMSETZER MIT MIS-VARAKTOREN]
Joerg Mueller 1972 135 p refs In GERMAN
Avail: NTIS HC $8.75

The electrical properties of semiconductor varactors are discussed. The application of varactors for frequency conversion is explained. Methods for measuring the amplitude phase modulation, intermodulation, impedance, and harmonics of intermediate frequencies of varactors are described. The characteristics of varactors which determine their selection for various applications are explained. A circuit diagram of the test equipment for analyzing varactor performance is provided. Transl. by P.N.F.

N74-13893# Defence Research Establishment Valcartier (Quebec).
PERFORMANCE OF A TEA CO2 DOUBLE-DISCHARGE GRID AMPLIFIER
J. L. Lachambre, J. Gilbert, F. Rheault, R. Fortin, and M. Blanchard Nov. 1973 24 p refs
(Proj. 97-01-07)
(DREV-R-685/73) Avail: NTIS HC $3.25

A discharge circuit designed for the pulsed excitation of a double-discharge mesh-cathode TEA amplifier system is described. The circuit which features a slow rate of electrical energy deposition in the amplifying discharge with pump pulses typically in the 2 to 6 microns range has resulted in a significant improvement in the stability and uniformity of the discharge. Small signal gain coefficients in to 0.035/cm were obtained with an electrical input energy density of 120 J/l in a 5 x 5 x 50 cu cm discharge volume. Details concerning the circuit design are given and the effects of variation in circuit parameters, gas mixture compositions (He-N2-CO2) and electrical energy input on the time development and spatial distribution of gain over the amplifier cross section are examined. Preliminary measurements of the gain saturation characteristics indicate a value of approximately 5 x 10 to the minus 20 cu cm for the stimulated emission cross section. Author

N74-13894*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A VARIABLE FREQUENCY INVERTER FOR ac INDUCTION MOTORS WITH TORQUE, SPEED AND BRAKING CONTROL Patent Application
Frank J. Nola, inventor (to NASA) Filed 19 Dec. 1973 17 p (NASA-Case-MFS-22088-1; US-Patent-Appl-SN-426155) Avail: NTIS HC $3.00 CSCL 09E

A variable frequency inverter is described for driving an ac induction motor which varies the frequency and voltage to the motor windings in response to varying torque requirements for the motor so that the applied voltage amplitude and frequency are of optimal value for any motor load and speed requirement. The slip frequency of the motor is caused to vary proportionally to the torque and feedback is provided so that the most efficient operating voltage is applied to the motor. Winding current surge is limited and a controlled negative slip causes motor braking and return of load energy to a dc power source. NASA

N74-13895*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOGIC-CONTROLLED SOLID STATE SWITCHGEAR FOR 270 VOLTS dc
G. R. Sundberg, D. Waddington (Martin Marietta Corp., Denver), and E. E. Buchanan, Jr. (Martin Marietta Corp., Denver) 1973 29 p ref Presented at the Power Electron. Specialists Conf., Pasadena, Calif., 11-13 Jun. 1973; sponsored by IEEE
(Contract NAS3-15824)
(NASA-TM-X-71483; E-7807) Avail: NTIS HC $3.50 CSCL 09E

A feasibility study to design and demonstrate solid state switchgear in the form of circuit breakers and a power transfer switch is described. The switchgear operates on a nominal 270 V dc circuit and controls power to a load of up to 15 amperes. One circuit breaker may be interconnected to a second breaker to form a power transfer switch. On-off and transfer functions of the breakers or the transfer switch are remotely controlled. A number of reclosures with variable time delay between tripout and reclosure are programmed and controlled by integrated analog and COSMOS logic circuits. A unique commutation circuit, that generates only minimal transient disturbance to either source or load, was developed to interrupt current flow through the main SCR switching element. Laboratory tests demonstrated performance of the solid state circuit breakers over specified voltage and temperature ranges. Author

N74-13896# Sandia Labs., Albuquerque, N.Mex.
EFFECTS OF GAMMA IRRADIATION ON LSA OSCILLATOR PERFORMANCE
W. E. Wilson [1973] 11 p refs Presented at the Conf. on Microwave Semicond. Devices, Circuits and Appl., Ithaca, N.Y., 14 Aug. 1973 Sponsored by AEC
(SLA-73-5429, Conf-730828-1) Avail: NTIS HC $3.00

The effects of gamma produced displacement damage and transient ionization in high peak power LSA diode oscillators were investigated. In the permanent damage case, total gamma dose causes carrier removal at the approximate rate of 4 x 0.001 carriers/cm/photon which leads to an increase in the low field resistance. In addition, both the magnitude of the negative mobility and the velocity peak to valley ratio appear to decrease.

These effects lead to an eventual reduction in the device breakdown voltage and an increase in frequency at a fixed bias, similar to those observed for neutron irradiation or temperature. Stabilization and an increased in the breakdown voltage of heavily-doped devices for total doses on the order of 10 to the 7th power rads (GaAs) were observed, and appear to be related to the decrease in the magnitude of the negative mobility as borne out by computer simulations. It is concluded that LSA oscillators appear to be immune to gamma irradiation to levels commensurate with most systems requirements. NSA

N74-13897# Daresbury Nuclear Physics Lab. (England).
RF MODULATED ELECTRON GUN FOR NINA INJECTION EQUIPMENT
T. R. Charlesworth, O. Gunnill, D. G. Peters, D. E. Poole, and G. Saxon 1973 19 p ref
(DNPL/R-29) Avail: AEC Depository Libraries HC $3.00

An 80 keV electron gun for the 40 MeV linear injector of NINA is described. The electron beam is RF modulated at 408 MHz before injection in the linac. The system carries practically all the current in two equal bunches which are best injected at about plus or minus 25 deg from the stable phase angle. The oxide cathodes give increasingly longer lives as the system clears up and better vacuum conditions are achieved. NSA

N74-13898# Radio Corp. of America, Princeton, N.J.
TRAPATT DIODES AND CIRCUITS FOR HIGH-POWER MICROWAVE GENERATION
S. G. Liu 1972 22 p refs Sponsored by AEC
(SLA-73-5763) Avail: NTIS HC $3.25

Among the known solid state microwave devices, the Trapatt diodes have a unique capability in generating high peak microwave power with high efficiency. Some of the developments in Trapatt devices and circuits for peak power generation in the hundred- and kilo-watt range are discussed. Device fabrication and performances of the n-type, p-type, and a recently developed double-ended Trapatt diode structure are presented. On circuit developments, experimental circuits operating in the fundamental and the harmonic extraction mode, as well as a miniature quasi-lumped oscillator circuit are discussed. The importance of bias impedance upon the performance of a Trapatt amplifier is also presented. Author (NSA)

N74-13899# IKOR, Inc., Burlington, Mass.
HIGH POWER TRAVATRON INVESTIGATION Final Report, 21 Oct. 1971 - 31 Dec. 1972
J. M. Proud, Jr. and W. H. McNeill Aug. 1973 85 p refs
(Contract F30602-72-C-0068)
(AD-767907; RADC-TR-73-227) Avail: NTIS CSCL 09/5

A program was conducted to investigate techniques associated with enhancing the peak power generating capabilities of the Travatron. Analyses aimed at optimizing power-to-size ratios of the device and determination of operating limits are reported. Various techniques for generation of high voltage pulses suitable for driving the Travatron are analyzed and tested. A breadboard model Travatron generating over 10 MW peak power in 10 ns pulses at 1.3 GHz is also described. Author (GRA)

N74-13900# Westinghouse Research Labs., Pittsburgh, Pa.
ELECTROLUMINESCENT FILM DISPLAY DEVICE Quarterly Report, 22 May - 22 Aug. 1972
Thomas P. Brody, Albert G. Fischer, William S. Escott, Edward W. Greeneich, and Willie Lehmann Jul. 1973 10004 p refs
(Contract DAAB07-72-C-0061; DA Proj. 1X6-63707-D-245)
(AD-768207; ECOM-0061-3-72; QR-3) Avail: NTIS CSCL 09/5

During the reporting period, operating 6 x 6 inch X-Y addressible arrays were fabricated. The process is now fairly reproducible, and the transistor characteristics in the matrix are good. The arrays constructed included isolated transistor patterns from which it was established that low leakage devices could be deposited with good yield and uniformity. Interconnected arrays of devices were also made with similar encouraging results; these are possibly the largest integrated circuits ever made. Conventional EL-phosphor lamps have been driven with state-of-the-art TFTs and the transfer characteristics are satisfactory. In an appendix, a new model for the deterioration of ac-electroluminescence is proposed. Author (GRA)

N74-13901# Aerospace Corp., El Segundo, Calif.
CARRIER DIFFUSION DEGRADATION OF MODULATION TRANSFER FUNCTION IN CHARGE COUPLED IMAGERS Technical Report, Feb. - Jun. 1973
David H. Seib 24 Aug. 1973 43 p refs
(Contract F04701-73-C-0074)
(AD-767903; TR-0074(4230-50)-3; SAMAO-TR-73-301) Avail: NTIS CSCL 17/8

Expressions for the modulation transfer function due to minority carrier diffusion in charge coupled imagers are calculated, following the approach used by Crowell and Labuda. Both front and rear optical illumination of the charge coupled imager are considered; for the rear illumination case interference effects are included. The modulation transfer function for electron excitation is also considered. In all cases, the expressions for the modulation transfer function have been evaluated using typical charge coupled imager parameters. The quantum efficiency predicted by the minority carrier diffusion model is also briefly discussed. Author (GRA)

N74-13902# Westinghouse Electric Corp., Baltimore, Md. Systems Development Div.
BINARY-ADDRESSABLE SCAN-CONVERSION STORAGE TUBE Quarterly Report, 15 Jan. - 14 Apr. 1973
Haden J. Bourg and Gary E. Mary Aug. 1973 40 p
(Contract DAAB07-72-C-0052)
(AD-767272; ECOM-0052-6-72; QR-6) Avail: NTIS CSCL 09/1

The objective of the contract is to conduct a research and development program leading to the fabrication, testing, and delivery of a binary-addressable scan-conversion storage tube. The tube is to be capable of simultaneous write and non-destructive read operation at video frequencies up to 10 megahertz. During this quarter the initial device was fabricated and tested using a circuit which allowed selection of any single electrode on the wafers in the stack. Additional etching experiments were conducted in an effort to evaluate the possibility of etching the hole arrays in the digitizer plates. A digital addressing system which should operate at 10 megahertz has been designed. This system will provide sufficient information to display a bar chart exhibiting eleven shades of gray in a sequential manner. It also allows demonstration of the random access capability to the individual target elements. (Modified author abstract) GRA

N74-13903# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
THE ac POWER CONTROLLERS FOR SOLID STATE DISTRIBUTION SYSTEM. VOLUME 1: DESIGN, DEVELOPMENT, FABRICATION, AND TEST OF HYBRID DEVICES Final Report, Jun. 1971 - May 1973
James T. Mitchell, W. W. Billings, K. C. Shuey, and C. M. Gauthier Sep. 1973 162 p
(Contract F33615-71-C-1900; AF Proj. 3145)
(AD-768199; WAED-73-12-Vol-1; AFAPL-TR-73-75-Vol-1)
Avail: NTIS CSCL 09/3

The report describes the work done in a program in which solid state power controllers were designed, developed, fabricated, and tested. Units rated 1.0 through 5.0 amperes; 230 volts, and 1.0 through 75 amperes, 115 volts, 400 Hz, were built using hybrid thick-film bare chip and wire techniques. Details of the test results, circuit designs, and recommendations are included as part of this report. Author (GRA)

N74-13904# Army Material Command, Texarkana, Tex.
DETECTION OF ELECTRICAL CONTACT WEAR USING VIBRATIONAL ANALYSIS
Neil H. Schiller May 1973 70 p refs
(AD-768131; USAMC-ITC-1-73-19) Avail: NTIS CSCL 09/1

The paper examines how the sound vibrations produced during operation of an electric contact are related to the number of operations to which it has been subjected. The examination is accomplished in two parts. First, the theories underlying Bridge and Arc Transfer phenomena in electric contacts are reviewed. This information is then used to predict how contact wear can

best be detected. The second part of the paper experimentally investigates how sound vibrations produced during operation of an electrical contact are related to the number of operations to which it has been subjected. The investigation is accomplished by measuring the sound produced during contact operation. The power spectral density of the sound records is then computed. Changes in the power spectral density records are then correlated to contact wear. The results of the experiment show that a pre-failure condition is detectable in the two electrical contacts tested. Author (GRA)

N74-13913 Louvain Univ. (Belgium).
THE USE OF THE TRANSISTOR SIMULATION PROGRAM SITCAP FOR STATISTICAL MODELING OF BIPOLAR TRANSISTORS
H. Deman, R. Merten, and H. Grevens *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

N74-13914 Norges Tekniske Hoegskole, Trondheim.
TRANSISTOR EQUIVALENTS
O. G. Kjaerstad *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 12 p refs (For availability see N74-13906 05-10)

N74-13915 Advisory Group for Aerospace Research and Development, Paris (France).
AN OPTIMIZATION TECHNIQUE TO CALCULATE BIPOLAR TRANSISTOR PARAMETERS
Ronald J. Covello (Ellsworth AFB, South Dakota) *In its* Computer Aided Design for Electron. Circuits Oct. 1973 12 p refs (For availability see N74-13906 05-10)

N74-13917 Advisory Group for Aerospace Research and Development, Paris (France).
UNIT TRANSISTOR. MODEL OF BIPOLAR TRANSISTOR HAVING CONTINUOUS PARAMETERS AS THE GEOMETRIC DIMENSIONS [TRANSISTOR UNITE, MODELE DE TRANSISTOR BIPOLAIRE EN CONTINU AYANT COMME PARAMETRES LES DIMENSIONS GEOMETRIQUES DES TRANSISTORS]
P. Leduc *In its* Computer Aided Design for Electron. Circuits Oct. 1973 14 p refs In FRENCH (For availability see N74-13906 05-10)

N74-13919 Bell-Northern Research Ltd., Ottawa (Ontario).
A COMPUTER PROGRAM FOR ANALYZING WAVEGUIDE STRUCTURES
Chuang-Jy Wu and Wayne Johnson *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

N74-13923 Laboratoire Central de Recherches Thomson-CSF, Orsay (France).
SYTHESIS OF PASSIVE FILTERS WITH INFINITE ATTENUATION POINTS REALIZED WITH WEAK NOISE COMPONENTS APPLIED TO HIGH DEGREE CAUER FILTERS [SYNTHESE DE FILTRES PASSIFS A POINTES D'ATTENUATION INFINIES REALISES AVEC DES COMPOSANTS A FAILBLES PERTES APPLICATION AUX FILTRES DE CAUER DE DEGRE ELEVE]
C. Gimenes *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs In FRENCH (For availability see N74-13906 05-10)

N74-13937 International Computers Ltd., Manchester (England). Microsystems Div.
COMPUTER AIDED PLACEMENT AND ROUTING OF HIGH DENSITY CHIP INTERCONNECTION SYSTEMS
N. R. Crocker, R. W. McGuffin, R. Naylor, and H. Vosper *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 26 p refs (For availability see N74-13906 05-10)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N74-13905*# Northeastern Univ., Boston, Mass.
DIFFUSION AND STRUCTURAL CHANGES IN MICROCIRCUIT INTERCONNECTIONS Final Report, 1 Dec. 1969 - 30 Jun. 1971
Welville B. Nowak 7 Sep. 1973 10 p refs
(Grant NGR-22-011-060)
(NASA-CR-132890) Avail: NTIS HC $3.00 CSCL 09C

The interdiffusion of platimum and gold films, a couple utilized in beam lead microcircuits, has been studied for temperatures up to 550 C. Gold-on-platinum couples and separate platimum and gold films 80-450 nm thick, were deposited by electron beam evaporation onto oxidized (111) silicon substrates. Diffusion was monitored by means of spectral reflectance versus wavelength in the band 500-1000 nm. The separate metal films showed good adhesion and stable reflectances (after an initial change) for at least 6 h at diffusion temperatures, in contrast to the couples. Analysis of platinum diffusion through the gold films yielded an activation energy about 38 kcal/g-atom and a pre-exponential factor of the order 0.001 sq cm/sec, values close to those for volume diffusion. The pre-exponential factor especially is dependent upon film deposition conditions. Author

N74-13906# Advisory Group for Aerospace Research and Development, Paris (France).
COMPUTER AIDED DESIGN FOR ELECTRONIC CIRCUITS
Oct. 1973 456 p refs Presented at 25th Tech. Meeting on the Avionics Panel of AGARD, Lyngby, Denmark, 21-25 May 1973
(AGARD-CP-130) Avail: NTIS HC $25.00

Conference papers are presented under the following headings: (1) reliability, (2) modelling, (3) microwave, (4) analog, (5) digital, and (6) layout. For individual titles, see N74-13907 through N74-13938.

N74-13907 Technical Univ. of Denmark, Lyngby. Institute of Circuit Theory and Telecommunication.
THE TEACHING OF CACA IN DENMARK
Erik Lindberg *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 9 p refs (For availability see N74-13906 05-10)

Computer aided circuit analysis (CACA) is a central discipline in the area of computer aided design of electronic circuits (CADEC). Since 1969, 10 courses in CACA have been offered and attended by about 190 persons. Nevertheless it has turned out that apparently it is very difficult to introduce CACA in the industry. The implementation and use are considered, of a common accessible library containing a number of programs for general circuit analysis. Two programs, ANP3 and NAP2, for linear and nonlinear systems analysis, respectively, are reviewed in brief.
Author

N74-13908 Computer Aided Design Centre, Cambridge (England). **c08**
ECONOMICS OF CAD: A NEW APPROACH
A. I. Llewelyn and G. C. Freeman *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 10 p refs (For availability see N74-13906 05-10)

The economics of CAD is dependent on the degree to which commonalities can be recognised over a wide application front and embodied into common interactive software and a flexible computer system. The CAD Centre has worked closely with industry over the whole engineering front in order to identify such commonalities, while at the same time keying its development to industrial needs and operating in a commercial environment where the economics of CAD is always in the forefront. The Centre's function and facilities and its method of operation are described. The economic advantages to be gained from the use of a common system developed through experience gained by multi-organization, multi-discipline working are discussed.
Author

N74-13909 Admiralty Surface Weapons Establishment, Portsmouth (England).
RELIABILITY RELATED TO COMPUTER AIDED CIRCUIT DESIGN: A USER'S VIEW **c15**
N. A. Walter and A. A. Kaposi *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 10 p (For availability see N74-13906 05-10)

The problems of using computer aided circuit design in the reliability field are discussed and some of the possible reasons for the low utilization of computer aided circuit design are given. A method of simulating system reliability, using computer aided circuit design type programs, is discussed and details given of such a method. Author

N74-13910 Radio Corp. of America, Moorestown, N.J. Government and Commercial Systems Div.
RELIABILITY AND COMPUTER AIDED DESIGN **c15**
James G. Smith *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

Information is presented to show that an integrated system of design aids raises the level of design assurance and thereby improves reliability. Topics of discussion include: (1) reliability at the expense of design complexity, (2) pertinent attributes of the computer, (3) standard cell automation, (4) the standard cell library, (5) computer aided circuit design, (6) logic simulation and test generation, (7) computer aided printed circuit board design, and (8) backplane wiring design automation. D.L.G.

N74-13911 Technical Univ. of Denmark, Lyngby.
COMPUTER AIDED DESIGN FOR MAXIMUM PRODUCTION YIELD OR MAXIMUM RELIABILITY **c15**
P. W. Becker and F. Jensen (Storno A/S, Copenhagen, Denmark) *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 14 p refs (For availability see N74-13906 05-10)

The use of computer aided design is demonstrated as a means of optimizing electronic circuit or system production yield, or, ultimately, drift reliability. A mathematical model for the yield or drift reliability is introduced, and methods for numerical evaluation hereof are briefly reviewed. The unhappy task of assembling pertinent component data for the computations is also touched upon. Various optimization techniques suitable for the problem at hand are next commented upon, and finally the theory is put into use by optimizing the yield of two transistor circuits. The results and implications of the optimization are discussed. Author

N74-13912 Electronique Marcel Dassault, St. Cloud (France).
COMPUTER AIDED DESIGN CONCEPTS [LA CONCEPTION DE PROJET ASSISTEE PAR ORDINATEUR]
J. P. Vedel *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 9 p In FRENCH (For availability see N74-13906 05-10)

A communication is presented on the use of computer concepts to aid in determining the reliability and costs of developing materials. The availability of the material was also considered. Transl. by E.H.W.

N74-13913 Louvain Univ. (Belgium).
THE USE OF THE TRANSISTOR SIMULATION PROGRAM SITCAP FOR STATISTICAL MODELING OF BIPOLAR TRANSISTORS **c09**
H. Deman, R. Merten, and H. Grevens *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

The program SITCAP is a simulator of bipolar transistors for computer aided circuit analysis. The main features of the program are its simple input-output structure and the new emitter model which is included in it. The main aspects of the program are described and examples are given of the application of the program for studying the statistical properties of bipolar transistors. It is demonstrated that in most cases the Gummel number must be taken as statistical variable, because the most important model parameters are correlated with it. Author

N74-13914 Norges Tekniske Hoegskole, Trondheim.
TRANSISTOR EQUIVALENTS **c09**
O. G. Kjaerstad *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 12 p refs (For availability see N74-13906 05-10)

A method is presented to find the linear equivalent circuits of operational amplifiers and bipolar transistors. The method is general, and the same method can be used to find the equivalent circuits of other components. The method is based upon using a CAD-program to minimize an error function by varying the component values of an equivalent circuit. The error function is derived from the difference between the computed response of the component, for example a transistor, and the known response. The known response can be the measured frequency response or derived from the manufacturer's data. The results of two projects are presented which include: (1) operational amplifier equivalent below 5 MHz, and (2) bipolar transistor equivalent below 30 MHz. A project to find the equivalent circuit at higher frequencies is outlined. Author

N74-13915 Advisory Group for Aerospace Research and Development, Paris (France).
AN OPTIMIZATION TECHNIQUE TO CALCULATE BIPOLAR TRANSISTOR PARAMETERS **c09**
Ronald J. Covello (Ellsworth AFB, South Dakota) *In its* Computer Aided Design for Electron. Circuits Oct. 1973 12 p refs (For availability see N74-13906 05-10)

Presently, a severe problem exists in nonlinear network analysis. Succinctly stated, this problem is that the measurement of the nonlinear parameters of bipolar transistors is time-consuming, difficult, and costly. An iterative computer technique is described for calculating these parameters using readily measured data. The technique uses a two level optimization process. Initially it assumes an arbitrary set of values for the parameters. It then calculates transistor currents based on these parameters and measured voltages. The calculated and measured currents are then compared and appropriate adjustments are made in the parameters. This process is repeated till calculated and measured values of transistor currents agree. At this time, the parameters are considered known. Results are shown which demonstrate the validity and applicability of the technique. Also, several minor modifications are suggested to optimize the process for production use. Author

N74-13916 Elektronikcentralen, Hoersholm (Denmark).
LINEAR TRANSISTOR MODELS IN HF NETWORK ANALYSIS. ADAPTION BETWEEN MEASUREMENTS AND ANALYSIS BY COMPUTER
P. Stangerup *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 22 p refs (For availability see N74-13906 05-10)

It is demonstrated that the problem of including transistor data in linear analysis programs is easily overcome by means of a simple mathematical model. This model can without difficulty be made to cover at least one decade at frequencies up to 1 GHz. At the higher frequencies, the best representation of the transistor is the S-matrix. Therefore, it is desirable to make greater use of analysis programs based entirely on the S-parameter representation. Author

N74-13917 Advisory Group for Aerospace Research and Development, Paris (France).
UNIT TRANSISTOR. MODEL OF BIPOLAR TRANSISTOR HAVING CONTINUOUS PARAMETERS AS THE GEOMETRIC DIMENSIONS [TRANSISTOR UNITE, MODELE DE TRANSISTOR BIPOLAIRE EN CONTINU AYANT COMME PARAMETRES LES DIMENSIONS GEOMETRIQUES DES TRANSISTORS] **c09**
P. Leduc *In its* Computer Aided Design for Electron. Circuits Oct. 1973 14 p refs In FRENCH (For availability see N74-13906 05-10)

The addition of high level injection to IBIS transistor model and the effect of such an addition on continuous transistor functions are investigated. The revised model is applied to the determination of parameters for two transistors. A comparison was made of the measured and calculated gain and function of the collector circuit. Transl. by E.H.W.

N74-13918 Siemens A.G., Munich (West Germany). Central Telecommunications Lab.
STATE OF ART AND FUTURE TRENDS OF COMPUTER-

AIDED DESIGN OF MICROWAVE INTEGRATED CIRCUITS

Hans-Norbert Toussaint and Reinmut Hoffmann *In* AGARD Computer Aided Design for Electron. Circuits Jan. 1973 14 p (For availability see N74-13906 05-10)

The future trend of MIC design will be to combine the previously separate CAD branches into one CAD system. The hardware and software complement of this system is described. The principal constituents of the software are a conversion program, which permits the network to be calculated directly from the circuit layout, and a data bank in which the measured properties of special MIC components (e.g. transmission line discontinuities, lumped elements) are stored. Author

N74-13919 Bell-Northern Research Ltd., Ottawa (Ontario).

A COMPUTER PROGRAM FOR ANALYZING WAVEGUIDE STRUCTURES **c09**

Chuang-Jy Wu and Wayne Johnson *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

A waveguide structure analysis program was developed in FORTRAN for implementation on an IBM 360/67 computer using the CP/CMS time sharing system. From an input of mechanical dimensions, equivalent circuits of waveguide obstacles are generated by using previously published theoretical and/or experimental results. Assuming that no evanescent mode interaction occurs between obstacles, an ABCD matrix manipulation is used to determine the overall network electrical response. In addition, a classical waveguide filter design program, temperature and mechanical stability tests, and a tuning procedure have been provided to help solve day to day engineering problems. Good agreement was obtained between measured and calculated results for waveguide transformers, and both bandpass and bandstop filters. The program is essentially a piece of powerful design equipment with broadband capability and provides the designer with instant tabulated performance information for analysis. Proper use of the program can save a considerable amount of model shop work and experimental effort in designing various types of waveguide networks. Author

N74-13920 Servizio Meteorologico Italiano, Milano.

COMPUTER OPTIMISATION OF MICROWAVE INTEGRATED CIRCUITS DESIGN

S. V. Judd *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 8 p ref (For availability see N74-13906 05-10)

The design and implementation of a numerical optimization procedure are described, suitable for realizing practical designs of hybrid microwave integrated circuits. Considerable attention was given to achieving low running costs in terms of computation time, in order to make the methods described, economically viable. Author

N74-13921 Technische Hogeschool, Delft (Netherlands). Microwave Lab.

DAP (DISTRIBUTION ANALYSIS PROGRAM): A PROGRAM FOR THE ANALYSIS AND DESIGN OF MICROWAVE CIRCUITS

Joseph L. Tauritz *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 23 p refs (For availability see N74-13906 05-10)

DAP is an easy to use computer program facilitating the analysis and design of microwave circuits employing lumped and distributed elements. At present it has been in general use for over two years in the Microwave Laboratory of the Delft University of Technology. DAP utilizes a modified chain matrix analysis scheme coupled to an extensive repertoire of microwave elements. Lumped and distributed elements such as resistors, capacitors, inductors, lossy transmission lines (both inline and stub), transformers, and arbitrarily specified ABCD matrices constitute the normal circuit elements. The program's versatility is enhanced by the ease with which new element models may be added by the user. The report includes an introduction to the mathematical basis of the program, with emphasis on its more unusual aspects, supplemented by a number of design examples. The creation of special purpose element types to facilitate phase shifter, transistor amplifier, and parametric amplifier analysis are described. A comparison with other presently available programs is made, serving designers in several Canadian cities. Author

and application of the program to optimization problems is discussed. Author

N74-13922 Toulouse Univ. (France).

MICROWAVE CIRCUIT ANALYSIS BY DIGITAL COMPUTER

C. Vidallon *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 10 p refs (For availability see N74-13906 05-10)

The program ACLINE was conceived for the treatment in the frequency domain of the most general form of linear active networks with lumped and distributed elements (stubs, lines, coupled lines, circulators, etc...). The components of the network may be described as black boxes, characterized by S, Y or Z parameters, and stored in a library with a code name. It is also possible to use subnetworks, that are, after treatment, considered as conventional black-boxes. Four types of controlled sources allow the optimum choice of active devices equivalent circuits. A great number of results may be obtained from ACLINE, including all parameters or functions currently used to characterize linear networks performances in the frequency domain. Sensitivities computation is made through two different methods. For a check over a great number of components a general method is used. A simple step-by-step optimization process may then be applied over a small number of sensitive parameters with a faster method (I.A.M.). Sophisticated mathematical models of microwave active devices are also included in the program (avalanche diode for example). Author

N74-13923 Laboratoire Central de Recherches Thomson-CSF, Orsay (France).

SYTHESIS OF PASSIVE FILTERS WITH INFINITE ATTENUATION POINTS REALIZED WITH WEAK NOISE COMPONENTS APPLIED TO HIGH DEGREE CAUER FILTERS [SYNTHESE DE FILTRES PASSIFS A POINTES D'ATTENUATION INFINIES REALISES AVEC DES COMPOSANTS A FAILBLES PERTES APPLICATION AUX FILTRES DE CAUER DE DEGRE ELEVE] **c09**

C. Gimenes *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs In FRENCH (For availability see N74-13906 05-10)

Computer synthesis of filters as a function of attenuation frequency and transfer function was discussed. After determining these functions, the impedance, overvoltage entering filter components, terminal resistance, and transmission loss were determined. Component values and filter schemes are included. The functional characteristics of the filter were compared to those of high performance Cauer filters. Transl. by E.H.W.

N74-13924 Societa Italiana Telecomunicazioni Siemens S.p.A., Milan (Italy).

COMPUTER DESIGN OF EQUAL RIPPLE EQUALIZATION **c07**

A. Maggi and N. Montefusco *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 8 p refs (For availability see N74-13906 05-10)

A digital computer program for automatic equalization of group-delay/frequency characteristics is presented. The program solves, in the most general manner, the problem of equal ripple equalization, with a limited computation time and a reduced number of positions in computer memory. The paper describes the iterative approximation process on a Newton-Raphson basis. An exhaustive analysis of the optimization and convergence of the procedure is also included. Finally the actual computer program is illustrated and some practical results are given. Author

N74-13925 Southampton Univ. (England).

COMPUTER AIDED ANALYSIS OF ELECTRONIC CIRCUITS ON A SMALL MACHINE

K. G. Nichols *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 10 p refs (For availability see N74-13906 05-10)

The reasons are explained for commencing computer-aided design activities on a small machine at Southampton University. The cost of running the machine for this purpose is estimated. Details of programs for small-signal linear-circuit ac analysis and non-linear circuit dc and transient analysis are given. Examples of costs using these programs are included. The problems

associated with implementing analysis programs on small machines are briefly discussed. Author

N74-13926 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Research Labs.
STRUCTURE AND APPLICATION OF COMPUTER PROGRAM ICAN: INTEGRATED CIRCUIT AC ANALYSIS
E. M. VanderOuderaa *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 15 p refs (For availability see N74-13906 05-10)

The computer program ICAN (Integrated Circuit Analysis) is capable of calculating ac properties (small signal) of bipolar integrated circuits. As input it needs technological data of the IC process, geometrical data (from the layout), and nodal connections. Details are given of the models used. To get an indication of the accuracy of ICAN it is applied to a current mode logic gate in the frequency range 100-500 MHz. The result is a reasonable agreement with measurements. To improve this agreement use was made of a more accurate two-dimensional transistor model. Author

N74-13927 Societe d'Etudes des Systemes d'Automation, Paris (France).
IMAG 2: ELECTRONIC CIRCUIT SIMULATIONS
Jean Arnould, J. P. Sicot, and Claude LeFaou (INPG) *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 7 p refs (For availability see N74-13906 05-10)

IMAG 2 is a simulation program of linear or non-linear electronic circuits. It allows the computation of the circuit's response under various conditions i.e. dc, ac, and transient analysis. It also gives the sensitivity of one or several output variables according to one or several circuit components. The program's use is simple and inexpensive because of the description's language and powerful calculation methods. Author

N74-13928 Rockwell International Corp., Anaheim, Calif.
COMPUTER AIDED DESIGN ANALYSIS OF MODERN LARGE SCALE CIRCUITS AND SUBSYSTEMS
W. Hochwald *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 41 p refs (For availability see N74-13906 05-10)

The SYSCAP (System of Circuit Analysis Programs)/SELECT (System Evaluation of Large-Scale Electronic Circuits and Transforms) family of computer programs ranks among the more powerful computer aids available to the design, production, reliability, and logistics engineer. As such, SYSCAP/SELECT encompasses proven technology in device modeling and mathematical structures, while stressing ease of usage and economy. Flexibility is provided to handle bipolar transistor electronics as well as MOS (Metal Oxide on Silicon) MSI/LSI (Medium and Large-Scale Integrated) circuits on an individual basis, in hybrid configurations, or in conjunction with functional system elements. The capabilities, user features, and options of SYSCAP/SELECT are presented. A circuit example and a control loop subsystem design example are given. Theoretical background data are presented to substantiate the solution processes that are utilized. Application areas where SYSCAP/SELECT has proven to be cost-effective are described with reference to the development cycle of complex modern electronic and electro-mechanical equipment. Author

N74-13929 Bell-Northern Research Ltd., Ottawa (Ontario).
AN EVOLVING, OPERATIONAL COMPUTER AIDED DESIGN SYSTEM c08
G. Scott, D. L. Williams, and L. C. Beaumont *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 12 p refs (For availability see N74-13906 05-10)

Computer graphics systems have not come into general use for computer aided design because of the high costs of both graphical hardware and graphical software. The equipment cost has decreased but programming costs remain high. A computer aided design system is described that uses a new high-level graphical language. The development of the language and of the translator and other programs in the system are also described. Some examples are given of applications using the language, which is at present running on a large time-sharing computer serving designers in several Canadian cities. Author

N74-13930 Brunel Univ., Uxbridge (England).
SPECIFICATION AND DESIGN LANGUAGES FOR LOGIC SYSTEMS c08
Douglas Lewin *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

The techniques are examined of representing logical processess in such a way that the resultant structures may be used both for the analysis and synthesis of the final system. The requirements for logic design languages are defined and current techniques are surveyed. The interactive design languages under development for the CALD system are described. D.L.G.

N74-13931* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE NASA COMPUTER AIDED DESIGN AND TEST SYSTEM c08
J. M. Gould and K. Juergensen *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 13 p refs (For availability see N74-13906 05-10)

A family of computer programs facilitating the design, layout, evaluation, and testing of digital electronic circuitry is described. CADAT (computer aided design and test system) is intended for use by NASA and its contractors and is aimed predominantly at providing cost effective microelectronic subsystems based on custom designed metal oxide semiconductor (MOS) large scale integrated circuits (LSIC's). CADAT software can be easily adopted by installations with a wide variety of computer hardware configurations. Its structure permits ease of update to more powerful component programs and to newly emerging LSIC technologies. The components of the CADAT system are described stressing the interaction of programs rather than detail of coding or algorithms. The CADAT system provides computer aids to derive and document the design intent, includes powerful automatic layout software, permits detailed geometry checks and performance simulation based on mask data, and furnishes test pattern sequences for hardware testing. Author

N74-13932 Societe Europeenne de Semiconducteurs et de Microelectronique, Paris (France).
SIGMA: AN INTEGRATED SYSTEM OF COMPUTER AIDED COMPLEX CIRCUIT DESIGNS [SIGMA: UN SYSTEME INTEGRE DE PROGRAMMES DE CONCEPTION ASSISTEE DES CIRCUITS COMPLEXES] c08
J. P. Lusinchi *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 25 p refs In FRENCH (For availability see N74-13906 05-10)

A detailed description is given of SIGMA a computer program designed to generate integrated and hybrid circuits. The program is divided into three parts: (1) IMAG 2T and PRIAM for analog simulation, (2) PSI for logical simulation and test sequence generation, and (3) GAMMA for diagram verification. Special circuits, costs, program applications are included.
Transl. by E.H.W.

N74-13933 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
A COMPUTER AIDED DESIGN SYSTEM FOR LARGE SCALE INTEGRATED DIGITAL NETWORKS c08
R. G. Hamer and C. S. Meyer *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

A CAD system presently being used in the design of LSI digital networks is described. Topics discussed cover logic system design and partitioning considerations, logic verification, circuit design, chip layout, and mask generation. Computer programs are described which aid the designer in logic simulation, fault detection, non-linear circuit analysis in dc and transient modes, routing of cell interconnect, and mask generation. Author

N74-13934 REDAC Software, Ltd., Tewkesbury (England).
COMPUTER AIDED DESIGN OF MULTILAYER PRINTED CIRCUIT BOARDS c08
W. E. Hillier *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 14 p refs (For availability see N74-13906 05-10)

The interactive computer layout of large multilayer printed

circuit boards, including through via hole boards as well as buried via hole boards, is described. A full description of the software used is given together with details of the hardware and man machine interface. The system used is shown to be an extension of the internationally proven REDAC double sided P.C.B. design package. The powerful software routines available for automatic routine and checking of the final layout are emphasized together with the ease with which the designer may interact with the program during its execution. It is shown that large layouts can be completed in a few weeks which would take a manual designer months to complete and would be very prone to manual designer error. Author

N74-13935 International Computers Ltd., Manchester (England).
OPTIMISING AUTOMATIC TRACKING OF MULTILAYER BOARDS
H. G. Adshead *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 16 p refs (For availability see N74-13906 05-10)

The paper commences with a brief but critical appreciation of some known automatic tracking techniques for multilayer printed circuit boards, viz. Maze-Running, Line-Search and Channel-Allocation. The purpose is to bring out their inherent similarity and to propound their specific superiority under different combinations of controlling criteria dictated by technological constraints. Consideration is given to the prohibitive core and time requirement for a real life environment involving an approximately 500 x 500 track matrix associated with the request for orthogonally connecting about 2500 pin-pairs, on each board. The evolution of an effective algorithm and list-structure capable of successfully handling this problem is discussed in detail. Several side issues of major significance are introduced. The efficient pre-sorting of the order in which wires are submitted to the main algorithm has been found to make a significant contribution to the efficiency of the entire system. Profile analysis is developed as a technique for comparing the relative merits of various topological placements of the logic network. The importance of the basic board layout and its relation to the algorithm employed is stressed. Author

N74-13936 University of Southern Calif., Marina del Rey.
A PARALLEL PRINTED CIRCUIT BOARD DESIGN SYSTEM
Donald R. Oestreicher *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 12 p refs (For availability see N74-13906 05-10)
(Contract F30602-70-C-0300)

A unique approach is described for the automatic design of printed circuit boards in which all functions can be accomplished in parallel. Instead of producing the layout wire by wire, as is currently the rule, the layout is produced by traversing the board in a raster scan fashion, routing all relevant wires in parallel. This allows all design functions to be accomplished simultaneously. The fact that the layout functions are done concurrently provides for greater feedback among the different functions, and therefore greater efficiency, as more relevant information is available to each function. The algorithm also makes great use of the commutivities introduced by integrated circuits. This is done by unbinding the circuit into a structure which describes all possible pin assignments, as defined by the relevant commutivities. This structure then maintains this information as the layout algorithm makes decisions to bind particular pins to particular logical signals. The structure not only remembers past decisions, but it also makes all derivative bindings required by the layout algorithm's decisions necessary to maintain the equivalence between the input circuit description and the actual implemented circuit.
Author

N74-13937 International Computers Ltd., Manchester (England). Microsystems Div.
COMPUTER AIDED PLACEMENT AND ROUTING OF HIGH DENSITY CHIP INTERCONNECTION SYSTEMS c09
N. R. Crocker, R. W. McGuffin, R. Naylor, and H. Vosper *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 26 p refs (For availability see N74-13906 05-10)

A novel approach to the problem of placement and interconnection of components is presented. Conventional constraints, such as substrate or circuit board dimensions, are not considered at the outset; they are either absent or are suppressed until the stage is reached at which they are directly applicable. The chosen approach was adopted to facilitate the placement and tracking of integrated circuit chips on a microwired array. This form of construction, orthogonal tracks on either side of a dielectric layer connected by etched through-holes, has the advantage that the holes may be made within the width of a track. The algorithms presented are technology-independent and may be applied to any interconnection system which incorporates this feature. Initially, the logic is placed on a continuous plane. From this state, it is gradually transmuted through various cellular structures defined, initially by the components, and finally by a combination of the components and their associated tracks. The culmination is an arrangement which, at all stages, is determined by the logic and not the technology. Author

N74-13938 International Business Machines Corp., Owego, N.Y.
ERGONOMIC CONSIDERATIONS OF INFORMATION DISPLAY AND CONTROL FOR DESIGN AUTOMATION SYSTEMS
William M. Gaddes *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 13 p refs (For availability see N74-13906 05-10)

A method is described for ensuring that appropriate considerations be given to the requirements of the intended users during system development. Trends in design automation systems are discussed; particularly with respect to the increased functional integration and interaction of the users with the system, as well as among multiple users. A method is described, based on user-oriented flow diagrams, which is intended to define the user requirements. A description is provided by which these diagrams are used to establish user requirements and to establish a communication link between the users and the system architects. Difficulties that may be expected with regard to user interfaces are listed, and the value of the method for establishing ergonomic design and evaluation criteria, procedural aids and methods, and educational materials is discussed. Author

N74-13939*# National Aeronautics and Space Administration, Washington, D.C.
ELECTRONIC CONTROL CIRCUITS: A COMPILATION Technology Utilization
[1973] 26 p
(NASA-SP-5964(01)) Avail: NTIS HC $3.00 CSCL 09C

A compilation of technical R and D information on circuits and modular subassemblies is presented as a part of a technology utilization program. Fundamental design principles and applications are given. Electronic control circuits discussed include: anti-noise circuit; ground protection device for bioinstrumentation; temperature compensation for operational amplifiers; hybrid gatling capacitor; automatic signal range control; integrated clock-switching control; and precision voltage tolerance detector.
K.M.M.

N74-13940# Brookhaven National Lab., Upton, N.Y.
SUPERCRITICAL HELIUM FACILITY FOR MEASURING HIGH VOLTAGE BREAKDOWN
E. B. Forsyth, R. B. Britton, J. Dean, J. E. Jensen, and K. Minati 1973 17 p refs Presented at Cryogenic Eng. Conf., Atlanta, 8-10 Aug. 1973 Sponsored by AEC and NSF
(BNL-18048; Conf-730805-8) Avail: NTIS HC $3.00

The superconducting power transmission cable under development consists of flexible, concentric coaxial conductors insulated by wrapped dielectric tape. Under operating conditions the insulation will be impregnated by the helium coolant. Thus an important part of the development program is to determine high voltage breakdown characteristics for a variety of dielectric tapes immersed in a supercritical helium environment. A pressure vessel has been constructed which contains the sample wound on a test mandrel. The mandrel has two stress cones which provide a smooth increase in electric field intensity to maximum value which is maintained along a simulated cable test section which is 60 cm long. The helium is maintained at a constant temperature in the vicinity of the stress cones and test section. The temperature and pressure can be varied within the pressure

chamber over the ranges 4.5 to 15 K and 1 to 16 x 100,000 N/sqm respectively. Author (NSA)

N74-13941# Harry Diamond Labs., Washington, D.C.
THIN-FILM HYBIRD MICROCIRCUITRY. PART 1: BOXCAR CIRCUIT FOR A CURRENT HDL FUSE SYSTEM
Adolph J. Edwards May 1973 18 p refs
(DA Proj. 1X2-63302-D-212)
(AD-768091; HDL-TM-73-10-Pt-1) Avail: NTIS CSCL 09/5

A thin-film hybrid version of the boxcar circuit for a current Harry Diamond Laboratories fuze system was developed. A single circuit was laid out and a computer program written to generate 4 identical circuit patterns using a computer-tape driven plotter. The resistor-conductor patterns were produced by standard photolithographic techniques, and discrete chip devices (diodes, capacitors, and transistors) were attached with conducting epoxy cement. Connections to the chip devices and to lead-out pins were made by thermocompression wire bonding to complete the circuit fabrication. Preliminary electrical tests indicated acceptable insertion losses of approximately 0.6 db and high-frequency roll-off points in the expected frequency range.
Author (GRA)

N74-13942# California Univ., Los Angeles. School of Engineering and Applied Science.
INTERFACE PHENOMENA IN INTEGRATED CIRCUIT OXIDES Final Report, 30 Jun. 1970 - 1 Jan. 1973
Cadambanguidi R. Viswanathan Jul. 1973 45 p refs
(Contract DAAB07-70-C-0283; DA Proj. 1S6-62705-A-440)
(AD-768218; UCLA-ENG-7359; ECOM-0283-F-70) Avail: NTIS CSCL 20/12

Ion transport in Metal-SiO2 Silicon structures were studied. A different migration rate from the silicon to the metal interfaces was found while the reverse migration has yet another rate. An excitation limited mobile ion transport model was proposed. By use of a ramp-voltage technique and C-V measurements after bias-heat stress, it was demonstrated that the number of mobile ions is given by a temperature dependent Boltzman distribution. The ramp-voltage technique is useful in determining total number of ions mobile at a given temperature but is not by itself sufficient to determine the transport properties. It was demonstrated that evaluation of oxide contamination by C-V curve shifts yields a lower than true value if the sample is not kept under positive bias and sweep bias applied only when the sweep voltage approaches closely the flat-band voltage. SiO2 layers were also fabricated by the pyrolitic decomposition of silane gas and the electrical properties as a function of annealing temperatures were studied. Electrical properties of films annealed at 1000C approach closely those of thermal oxides. Recommendations for further oxide studies are given. Author (GRA)

N74-13943# Army Electronics Command, Fort Monmouth, N.J.
MAGNETIC CIRCUIT DESIGN STUDIES FOR AN INDUCTIVE SENSOR
Herbert A. Leupold, Frederick Rothwarf, Carl J. Campagnoulo, Henry Lee, and Jonathan E. Fine Oct. 1973 65 p refs
(DA Proj. 1W2-62301-A-300)
(AD-768160; ECOM-4158) Avail: NTIS CSCL 19/1

A procedure for calculating the approximate voltage outputs of a class of magnetic fuze transducers was developed. The method is applied to three different configurations to be used in artillery shells and the results compared with both prior and subsequent measurements made at Harry Diamond Laboratories (HDL). The agreement of the calculated voltage vs velocity curves with those obtained experimentally is surprisingly good, the deviation in all cases falling well within 10%. For one of these configurations more precise computer calculations are done as well. These agree with our approximation procedure to within less than 3%. The approximate long-hand method is then employed to recalculate the output voltages expected if the Alnico 5 magnets presently used were replaced by Co5Sm. An approximately 50% increase in output is predicted for the two more efficient configurations while for the remaining case the effect of the replacement of material is, if anything, slightly deleterious. Various experimental tests of some of the underlying assumptions were made to verify as much as possible the general applicability of the techniques employed. Author (GRA)

N74-13944# Clarkson Coll. of Technology, Potsdam, N.Y.
FAULT-DETECTION EXPERIMENTS ON STRUCTURALLY DECOMPOSABLE SEQUENTIAL MACHINES Interim Report
Purnendu Das and Daniel E. Farmer Jul. 1973 99 p refs
(Contract F30602-72-C-0463; AF Proj. 9567)
(AD-767213; RADC-TR-73-216) Avail: NTIS CSCL 09/2

The report treats the problem of devising fault-detection experiments for sequential machines having their decompositions known. In these experiments inputs are applied at the input terminals of the machine and the outputs observed at the output terminals, and no intermediate terminal is accessible. The output at any intermediate terminal is assumed known only for the design of the test but is never used in the actual experiment. The problem is treated from the standpoint of machine identification, with a possible faulty machine being identified as either isomorphic to its faultfree counterpart or not isomorphic to it. A test for a component machine is designed such that all the states of the component are identified and also sufficient non-elementary transitions are identified for unique representation of the machine. (Modified author abstract) GRA

N74-14672 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 5: ELECTRICITY [FACHGEBIET 5: ELEKTRONIK]
In its DFVLR Annual Review, 1972 1972 p 283-315 refs
In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N74-13945# Swedish Space Corp., Solna
ESRANGE FOR SCIENTIFIC RESEARCH USING SOUNDING ROCKETS AND BALLOONS
1973 23 p Original contains color illustrations
Avail: NTIS HC $3.25

An overall description is given of Esrange, a sounding rocket range located in northern Sweden, where scientists from different countries are allowed to use the facilities provided. Types of experiments conducted at Esrange include studies of electric and magnetic fields, auroral particles, noctulucent clouds, and structure of the Arctic mesosphere. Launchers are provided for Centaur, Skylark, and Nike vehicles. Instrumentation is described for telemetry, tracking, trajectory calculations, communications, and wind measurements. Information on cost, facilities, and transportation to Esrange is included. K.M.M.

N74-13946# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
PRELIMINARY NOISE MEASUREMENTS IN THE OPEN-JET OF THE VKI LOW SPEED WIND TUNNEL, L-1
R. B. Oetting May 1973 29 p refs
(TN-89) Avail: NTIS HC $3.50

The acoustical measurements made on the von Karman Low Speed Wind Tunnel, L-1 are summarized. The purpose of these measurements was to acquire data indicating the types of acoustical measurements which can be made in the three m diameter open-jet test section of the tunnel. The series of measurements include: (1) evaluation of the 1/3 octave band noise levels in the test section as a function of tunnel speed; (2) mapping of the sound field in the test section produced by a jet-nozzle located at the test section center point; and (3) noise characteristics of the jet-nozzle as a function of distance outside the tunnel jet. An analysis of the measured data indicates that the open jet test section of the low speed wind tunnel has potential as an environment for performing some types of acoustical measurements. The validity of the test results depend

on the type of noise source to be investigated, the microphone location for noise measurements, and the air flow conditions.
Author

N74-13947*# Sverdrup and Parcel, Inc., St. Louis, Mo.
STUDY OF METHODS OF IMPROVING THE PERFORMANCE OF THE LANGLEY RESEARCH CENTER TRANSONIC DYNAMICS TUNNEL (TDT)
Jun. 1973 282 p
(Contract NAS1-11687)
(NASA-CR-132378) Avail: NTIS HC $16.25 CSCL 14B

A study has been made of possible ways to improve the performance of the Langley Research Center's Transonic Dynamics Tunnel (TDT). The major effort was directed toward obtaining increased dynamic pressure in the Mach number range from 0.8 to 1.2, but methods to increase Mach number capability were also considered. Methods studied for increasing dynamic pressure capability were higher total pressure, auxiliary suction, reducing circuit losses, reduced test medium temperature, smaller test section and higher molecular weight test medium. Increased Mach number methods investigated were nozzle block inserts, variable geometry nozzle, changes in test section wall configuration, and auxiliary suction.
Author

N74-13948*# Singer Co., Binghamton, N.Y. Simulation Products Div.
SHUTTLE MISSION SIMULATOR. VOLUME 2: REQUIREMENT REPORT, VOLUME 2, REVISION C
J. F. Burke 21 Dec. 1973 166 p Revised
(Contract NAS9-12836)
(NASA-CR-134167) Avail: NTIS HC $10.50 CSCL 14B

The requirements for space shuttle simulation which are discussed include: general requirements, program management, system engineering, design and development, crew stations, on-board computers, and systems integration. For Vol. 1, revision A see N73-22203, for Vol 2, revision A see N73-22204.
F.O.S.

N74-13949*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WIND SENSITIVITY STUDIES OF A NON-RETURN WIND TUNNEL WITH A 216- BY 432-mm (8.5- BY 17.0-INCHES) TEST SECTION, PHASE 2
William T. Eckert, Kenneth W. Mort, and J. E. Piazza Aug. 1973 123 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-62307) Avail: NTIS HC $8.25 CSCL 14B

The refinement of inlet and exit treatments were studied which would minimize the effect of external wind on the test-section flow quality of a nonreturn wind tunnel. The investigation was conducted in the Ames Research Center 40- by 80-foot Wind Tunnel which served as the wind source. Several inlets and two exits were tested at wind directions ranging from 0 to 180 degrees and at wind-to-test-section velocity ratios from zero to somewhat greater than one. For the best inlet configuration the flow quality was good, with a velocity deviation in each of the three component directions generally less. The loss in total pressure due to the inlet treatment was low: about 0.035 of the test-section dynamic pressure for the no-wind case.
Author

N74-13950*# Ion Physics Corp., Burlington, Mass.
THE 20 KILOVOLT ROCKET BORNE ELECTRON ACCELERATOR Final Report
Robert Harrison Nov. 1973 256 p Original contains color illustrations
(Contract NAS9-10399)
(NASA-CR-134168) Avail: NTIS HC $15.00 CSCL 14B

The accelerator system is a preprogrammed multi-voltage system capable of operating at a current level of 1/2 ampere at the 20 kilovolt level. The five major functional areas which comprise this system are: (1) Silver zinc battery packs; (2) the electron gun assembly; (3) gun control and opening circuits; (4) the telemetry conditioning section; and (5) the power conversion section.
Author

N74-13951*# Texas A&M Univ., College Station.
REMOTE SENSING CENTER Technical Activity Summary, Sep. 1972 - Sep. 1973
Dec. 1973 108 p refs
(Grant NGL-44-001-001)
(NASA-CR-136529; RSC-06) Avail: NTIS HC $7.50 CSCL 14B

The applications are reported of new remote sensing techniques for earth resources surveys and environmental monitoring. Applications discussed include: vegetation systems, environmental monitoring, and plant protection. Data processing systems are described.
F.O.S.

N74-13952# Argonne National Lab., Ill.
A REPORT ON THE DEVELOPMENT OF INTENSE NEUTRON SOURCE FACILITIES FOR THE CTR TECHNOLOGY PROGRAM
P. J. Persiani Aug. 1973 32 p refs
(Contract W-31-109-eng-48)
(ANL/CTR-73-1) Avail: NTIS HC $3.75

Deuterium-tritium neutron facilities are classified in three groups: (1) accelerator and target systems, (2) dense plasma focus, supersonic gas-jet target, liquid-jet target (LiT), laser-plasma interaction, electron beam-plasma interation, and drift-orbit cyclotron heating, and (3) linear theta pinch, mirror machines, and others. Design related considerations are described for each.
NSA

N74-13953# Sandia Labs., Albuquerque, N.Mex.
MODERNIZATION OF SANDIA LABORATORIES' TRISONIC AND HYPERSONIC WIND TUNNELS
C. W. Peterson 1973 28 p refs Presented at 40th Semiannual Meeting of the Supersonic Tunnel Assoc., Bedford, United Kingdom, 24 Sep. 1973 Sponsored by AEC
(SLA-73-5708; Conf-730932-1) Avail: NTIS HC $3.50

Since 1956 more than 20,000 tests involving aircraft, rockets, and reentry vehicles have been made in the trisonic and hypersonic wind tunnels. Due to recent advances in vehicle performance, these wind tunnels are unable to reproduce realistic flight conditions, cannot meet the more stringent flow-quality requirements imposed by modern rocket and reentry systems, and cannot meet proposed standards for safe operation and proof testing. Therefore, the wind tunnel facilities are being modernized. Data are presented on the deficiencies of each wind tunnel, plans for correcting these deficiencies, calibration of existing wind tunnel instrumentation, and development of new diagnostic techniques.
NSA

N74-13954# Army Transportation Engineering Agency, Newport News, Va.
RESTRAINT PROCEDURES FOR CARGO LOADED IN VEHICLES TO BE AIR TRANSPORTED
Louis Zabohonski, Jr. Aug. 1973 46 p
(AD-768172; USATEA-73-23) Avail: NTIS CSCL 13/6

The report covers an analysis of the strength of the side racks of Army tactical cargo vehicles to determine their suitability to restrain cargo during air transport. The shear strength of the attachment of the cargo bed to the frame is defined based on information furnished from the US Army Tank-Automotive Command (USATACOM). Outlined are procedures for properly loading and restraining cargo in vehicles, using commonly available material. Results of the report indicate that the cargo bed shear from the frame and that these loads can be adequately restrained to the vehicle. The report also reveals potential problems in analyzing aircraft floor loads when the cargo is a loaded vehicle.
Author (GRA)

N74-13955# Naval Civil Engineering Lab., Port Hueneme, Calif.
VIBRATORY LOCOMOTION
H. A. Gaberson and P. L. Stone Jul. 1973 40 p refs
(ZF61512001)
(AD-767634; NCEL-TN-1292) Avail: NTIS CSCL 13/6

A new method for accomplishing land locomotion by vibrating a mass attached to a skid has been developed. The mass oscillates in an inclined direction, upward and forward, downward and backward. On the up-forward stroke it lifts the skid and pulls it forward; on the down-backward stroke it pushed the skid into the ground and the increased friction inhibits backslide. The report

presents the essentials of the theory of operation, design chart, and reports on experiments with test skids. Author (GRA)

N74-13956# Naval Ordnance Lab., White Oak, Md.
PROPOSED MODERNIZATION OF THE SPHERICAL FIELD COIL FACILITY, BUILDING 203
Milton H. Lackey 11 Jun. 1973 31 p refs
(AD-767931; NOLTR-73-128) Avail: NTIS CSCL 14/2

The report is a proposal for the modernization of the Spherical Field Coil Facility, Building 203, at the Naval Ordnance Laboratory. The modernization is directed at instrumenting the facility for the conduct of magnetic tests on large satellite systems for the Naval Research Laboratory. The proposal consists mainly of a description of two major instrumentation systems; the magnetic field generation and stabilization system, and the data acquisition and analysis system. A brief description is also included of the coil system, and of the supporting analytic studies. Building 203 is an ideal facility for satellite testing because of the large entrance, the reinforced floor, and the high-quality coil system. Author (GRA)

N74-13957# Braun (C. F.) and Co., Alhambra, Calif.
TURBOJET AIRCRAFT ENGINE TEST CELL POLLUTION ABATEMENT STUDY Final Report, Jul. - Dec. 1972
George F. Davies and Richard H. Crow 29 Jun. 1973 96 p refs
(Contract N62399-72-C-0020)
(AD-768287; NCEL-CR-74.001) Avail: NTIS CSCL 21/5

The report summarizes the results of a survey and analysis of the application of conventional air pollutant abatement systems to the exhaust gas from jet engine test cells. The following methods for gas treatment were investigated: wet scrubbers, incinerators, electrostatic precipitators, filters, dry inertial collectors. The least costly methods for meeting present emission standards are water scrubbing systems. One of the most attractive of wet scrubbers using Koch Flexitrays is developed in detail. The report covers the associated problem of water supply and disposal. The report also includes research and development suggestions for test cell emission control. Author (GRA)

N74-13958# Ford Motor Co., Dearborn, Mich. Transportation Research and Planning Office.
PRELIMINARY DESIGN STUDIES OF MAGNETIC SUSPENSIONS FOR HIGH SPEED GROUND TRANSPORTATION Final Report on Tasks 2/3, Feb. 1972 - Mar. 1973
John R. Reitz, Robert H. Borcherts, L. C. Davis, T. K. Hunt, and Dennis F. Wilkie Mar. 1973 315 p refs
(Contract DOT-FR-10026)
(PB-223237/9GA; FRA-TR-73-27) Avail: NTIS HC$7.00 CSCL 13F

The report examines certain critical problem areas relative to magnetic suspension of high-speed vehicles and develops a baseline for a TMLRV (tracked magnetically leviated research vehicle). Both types of magnetic suspension the repulsive-force suspension and the attractive-force suspensin, are considered. The present study has not turned up any problems serious enough to completely climinate one of these competing suspensions. Areas considered in the report include propulsion systems and their compatibility with magnetically-leviated high-speed vehicles, aerodynamic effects, failure modes, studies of ride quality, and criteria for maximum allowable track roughness. In regard to the repulsive-force suspension, experiments have been carried out to measure ac loss in the superconducting magnets and an assessment of th magnetic shielding requirement has been made. Two model electromangnets for the attractive-force suspension, and their feedback control systems, were built and tested during present study. GRA

N74-14285 Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
POLLUTION CONTROL OF AIRPORT ENGINE TEST FACILITIES
D. L. Baily, P. W. Tower, and A. E. Fuhs *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 32 p refs (For availability see N74-14271 05-20)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N74-13959 Carnegie-Mellon Univ., Pittsburgh, Pa.
ENTRANCE PRESSURE LOSSES FOR INELASTIC NEWTONIAN AND NON-NEWTONIAN FLUIDS Ph.D. Thesis
Stephen Edward Kaye 1973 169 p
Avail: Univ. Microfilms Order No. 73-21079

Entrance pressure losses have been measured for inelastic fluids flowing through contractions in cylindrical tubes. A mathematical model is developed to show the variation in pressure with Reynolds number. Coefficients to be used with various fluids to correlate the ratio of tube areas were determined. A recoil method was developed to determine the qualitative levels of elasticity in dilute polymer solutions. Dissert. Abstr.

N74-13960 New York Univ., N.Y.
THREE-DIMENSIONAL COMPRESSIBLE BOUNDARY LAYER FLOW OVER A YAWED CONE WITH MASS INJECTION Ph.D. Thesis
Ohyun Rho 1973 191 p
Avail: Univ. Microfilms Order No. 73-19402

An analytical scheme called the method of multi-interval expansions was introduced to solve the equations of the three-dimensional boundary layer flow. In multi-interval expansions, the solutions of the boundary layer equations in the interval are expressed in terms of those of the previous interval in such a way that all the physical properties and the relevant differential equations are continuous at the boundary between intervals. Consequently, the solutions for the whole flow field are obtained if the solutions of the first interval have been obtained. The first interval can be chosen, in general, as any region of the flow field. However, it may be preferably chosen as a domain, if possible, of the flow field where the governing differential equations are simplified in view of the nature of the flow field at that particular domain, for example, the plane of symmetry of a yawed cone. Dissert. Abstr.

N74-13961 Virginia Polytechnic Inst. and State Univ., Blacksburg.
NUMERICAL SOLUTION OF A BUOYANT JET IN A CROSS FLOW Ph.D. Thesis
Chung Jen Chien 1973 283 p
Avail: Univ. Microfilms Order No. 73-23441

Exact numerical solutions are presented for a three dimensional, buoyant jet in a cross flow. The steady state Navier-Stokes Equations written in terms of velocity, vorticity and temperature with the Boussinesq approximation are used in the computation. The solutions are obtained through the successive overrelaxation iteration method, and several finite difference formulations associated with the convection term are discussed. A computer program and a user's manual associated with several alternate formulations are given. Both uniform and variable spaced grids were used. In order to test the accuracy of the resulting solutions, detailed comparisons were made with experimental results for the laminar flow in the entrance region of a square channel. Dissert. Abstr.

N74-13962 State Univ. of New York, Albany.
THE SPECTRAL CHARACTERISTICS OF THE BAROCLINIC ANNULUS WAVES Ph.D. Thesis
Samohineeveesu Trivikrama Rao 1973 156 p
Avail: Univ. Microfilms Order No. 73-24370

A study on the statistical nature of the different flow patterns in the annulus was undertaken. The power spectra, cospectra and bispectra of the temperature data taken from thermocouples imbedded in the interior of the fluid reveal that the finite amplitude state of the regular wave regime is characterized by having a dominant peak, at a frequency corresponding to the observed frequency, and a regular series of higher harmonics, both in frequency and wave number space, whose power decreases rapidly as the harmonic number increases. The production of these higher harmonics is shown from bispectra to be essentially due to the

nonlinear triad interactions between the dominant wave, itself, and the other harmonics. The dominant peak and the higher harmonics are highly coherent around the annulus.
Dissert. Abstr.

N74-13963 Michigan Univ., Ann Arbor.
A TEST PARTICLE MONTE CARLO METHOD WITH APPLICATION TO THE FREE JET EXPANSION PROBLEM Ph.D. Thesis
Thomas William Tuer 1973 207 p
Avail: Univ. Microfilms Order No. 73-24704

A Monte Carlo method was developed for investigating flows of rarefied gases. The method can be applied to problems involving elastic collisions. The procedure is based on the test particle method, but the discontinuous function generally employed in the past for describing the target molecules' velocity distribution is replaced here by a continuous distribution function. This modification simplifies the calculations considerably, reduces the computer time and storage requirements, and facilitates the application of the method to multi-dimensional problems. The validity, accuracy and versatility of the technique was evaluated by obtaining solutions to several one dimensional problems for which other results exist. Dissert. Abstr.

N74-13964 Colorado Univ., Boulder.
A LABORATORY STUDY OF THE TURBULENT EKMAN LAYER Ph.D. Thesis
Jan Frederick Kreider 1973 131 p
Avail: Univ. Microfilms Order No. 73-23271

The objectives of this thesis were: (1) to develop experimental equipment and measurement techniques to investigate the flow in neutrally stratified, turbulent Ekman boundary layers; and (2) to compare the velocity profiles in turbulent Ekman layers measured in the laboratory with the flow predicted by theoretical models as well as with neutrally stratified atmospheric wind profiles. The results of the experiment verify the existence of inner and outer regions in the boundary layer. Each region was found to have the velocity and spatial scale factors predicted by an asymptotic similarity theory proposed by Blackadar and Tennekes. The universal velocity profile laws predicted by their theory were also verified by the experimental measurements, although flow curvature effects, which are present in the apparatus but not considered in the theory, influenced the shape of the velocity profiles. However, near the disk surface the velocity profiles could be predicted by a simple eddy viscosity model.
Dissert. Abstr.

N74-13965 West Virginia Univ., Morgantown.
APPLICATION OF A SIMPLE EDDY VISCOSITY MODEL TO CHANNEL AND BOUNDARY LAYER FLOW Ph.D. Thesis
Joseph Shing Mei 1973 173 p
Avail: Univ. Microfilms Order No. 73-23885

A simple eddy viscosity expression is obtained by modifying a simple linear variation to conform to constraints near the wall and on the axis. The equations for turbulent Poiseuille and plane Couette flow are then integrated in closed form to obtain the velocity distribution and friction coefficients. The results for pipe flow are in very good agreement with experiment. In the case of Couette flow where there is an apparent discrepancy between the experimental results of Reichardt and Robertson, both sets of data can be fitted by adjusting the value of b. Two analyses, an integral approach and a differential approach, are presented for the flat plate boundary layer. Both approaches gave velocity distributions, form factors, and friction coefficients in good agreement with experiment for values of the constants in the eddy viscosity expression differing somewhat from each other and from those used for pipe flow. Dissert. Abstr.

N74-13966 Polytechnic Inst. of Brooklyn, N.Y.
THE INTERACTION OF A HYPERSONIC PLUME WITH AN EXTERNAL HYPERSONIC STREAM Ph.D. Thesis
John Theodore Kelly 1973 164 p
Avail: Univ. Microfilms Order No. 73-24773

A theoretical study of the gas dynamic interaction between a hypersonic plume and the opposed hypersonic external stream is presented. Steady, axisymmetric, inviscid, perfect gas flow is postulated for both the bow and far field regions. Limiting forms of solutions are obtained for the bow region by application of the Newton-Busemann approximation to both the exhaust plume and ambient air flow. Through asymptotic expansions and their matching, it is found that six regions are required to adequately describe the bow region. Dissert. Abstr.

N74-13967 Notre Dame Univ., Ind.
AN ANALYTIC METHOD FOR THE CALCULATION OF FLOW FIELDS IN THE TRANSONIC REGION OF NOZZLES Ph.D. Thesis
Arthur Edward Fanning 1973 110 p
Avail: Univ. Microfilms Order No. 73-24312

A direct method for obtaining the flow field in the transonic region of a propulsive device is developed. The basis of the method is a reformulation of the normally mixed type of problem in terms of an elliptic problem. This simplification is brought about by expressing the nonlinear compressibility terms as a function of the spacial coordinates. The reformulation of the problem introduces the necessity of specifying a boundary condition on the outflow boundary and uncovers an auxiliary condition which aids in determining the mass flow through the nozzle. The problem of applying the boundary conditions on the normally complex curve, which describes the geometry of a propulsive nozzle, is circumvented by a conformal transformation of geometry to a plane in which the geometry is a rectangle. A convergent sequence of approximations to both the compressibility function and the outflow boundary condition is developed.
Dissert. Abstr.

N74-13968 Virginia Polytechnic Inst. and State Univ., Blacksburg.
NUMERICAL AND EXPERIMENTAL STUDIES OF THE NATURAL CONVECTION FLOW WITHIN A HORIZONTAL CYLINDER SUBJECTED TO A UNIFORMLY COLD WALL BOUNDARY CONDITION Ph.D. Thesis
Roger Bell Stewart 1973 140 p
Avail: Univ. Microfilms Order No. 73-23437

Numerical solutions are obtained for the quasi-compressible Navier-Stokes equations governing the time dependent natural convection flow within a horizontal cylinder. The early time flow development and wall heat transfer is obtained after imposing a uniformly cold wall boundary condition on the cylinder. Solutions are also obtained for the case of a time varying cold wall boundary condition. Windward explicit differencing is used for the numerical solutions. The viscous truncation error associated with this scheme is controlled so that first order accuracy is maintained in time and space. The results encompass a range of Grashof numbers from 83,400 to 7 times 10 to the 7th power which is within the laminar flow regime for gravitationally driven fluid flows. Experiments within a small scale instrumented horizontal cylinder revealed the time development of the temperature distribution across the boundary layer and also the decay of wall heat transfer with time. Dissert. Abstr.

N74-13969# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
TURBULENCE MODELS AND THEIR EXPERIMENTAL VERIFICATION. 14: OPEN FORUM DISCUSSION
Apr. 1973 10 p
(HTS/73/29) Avail: NTIS HC $3.00

Mathematical models for defining the characteristics of gas and fluid flows are discussed. The advantages and disadvantages of the various systems are analyzed. Suggestions are made for improving the accuracy of the models and developing procedures which will permit more simplified analysis of flow characteristics.
Author

N74-13970# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
TURBULENCE MODELS AND THEIR EXPERIMENTAL VERIFICATION. 7: REYNOLDS-STRESS MODELS - I
B. E. Launder Apr. 1973 24 p refs
(HTS/73/22) Avail: NTIS HC $3.25

A model of turbulent flow is developed in which turbulent stress components are the dependent variables of a set of transport equations. The nonisotropic nature of the turbulent viscosity in a three dimensional velocity field requires reference to the transport equations for the Reynolds stress to calculate the degree of anisotropy. The exact equations for Reynolds stress are presented.

The models approximate three processes in the stress equations: (1) dissipation, (2) pressure-strain effects from purely turbulence interactions, and (3) pressure-strain effects from mean field interactions. Author

N74-13971# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
TURBULENCE MODELS AND THEIR EXPERIMENTAL VERIFICATION. 11: SCALAR PROPERTY TRANSPORT BY TURBULENCE
B. E. Launder Apr. 1973 25 p
(HTS/73/26) Avail: NTIS HC $3.25

Mathematical models are developed to analyze the properties of turbulent air flow. The exact equation for transport expresses the following: (1) interactions of heat fluxes and temperature gradient tending to increase the fluctuations, (2) spatial gradients leading to a diffusion of fluctuations, and (3) destruction of temperature gradients by molecular conduction in the small scale eddies. Additional mathematical models are developed for heat transport in buoyancy affected flows, calculation of clear air turbulence, and prediction of concentration levels in confined jets. Author

N74-13972# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
TURBULENCE MODELS AND THEIR EXPERIMENTAL VERIFICATION. 9: REYNOLDS-STRESS MODELS - II
B. E. Launder Apr. 1973 26 p
(HTS/73/24) Avail: NTIS HC $3.50

Mathematical models of the effects of stress diffusion in the Reynolds-stress equations are developed. Variations of the gradient diffusion hypothesis are used to determine stress diffusion. Graphs are presented to compare the theoretical data with results obtained during experiments. Various conditions which were investigated include: (1) the asymptotic jet in a moving stream, (2) flow near walls, (3) plane channel flow, and (4) asymmetric plane channel flow. Author

N74-13973# Technischen Universitaet, Munich (West Germany).
EXPERIMENTAL AND THEORETICAL STUDIES ON THE MODELLING PROBLEM FOR CAVITATION FLOW Ph.D. Thesis [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN ZUM PROBLEM DER MODELLMAESSIGEN BEHANDLUNG VON STROEMUNGSKAVITATION]
Andreas Keller 1973 126 p refs In GERMAN
Avail: NTIS HC $8.50

In conjunction with an optical measuring technique for the cavitation nuclei, cavitation tests were carried through on families of axially symmetric bodies of various shapes. The onset of the cavitation at the submerged bodies proved to be strongly influenced by the nuclues spectrum of the liquid. The degree of dependency on the spectrum is also affected by the pressure gradient in the flow. A comparison of the measured nucleus spectrums and the critical nucleus sizes, which have been determined by theoretical stability considerations, produced a general agreement. This confirms the validity of the nucleus model of Harvey. The test results lead to the conclusion that diffusion does not remarkably influence the nuclei. Though the scattered light counting method cannot distinguish between gas bubbles and solid particles, the nucleus spectrum which has been obtained with the help of the method is still very informative. Author

N74-13974# Technischen Universitaet, Munich (West Germany).
MEASUREMENT OF THE ABSOLUTE AND RELATIVE FLOW FIELD IN A RAPID FRANCIS TURBINE CONSIDERING VORTEX TRAIN EFFECTS IN THE SUCTION PIPE Ph.D. Thesis [MESSUNG DES ABSOLUTEN UND RELATIVEN STROEMUNGSFELDES EINER SCHNELLAEUFIGEN FRANCISTURBINE MIT BERUECKSICHTIGUNG DER WIRBELZOPFERSCHEINUNGEN IM SAUGROHR]
Guenter Schlemmer 1973 160 p refs In GERMAN
Avail: NTIS HC $10.00

A research project to measure the flow conditions in a Francis turbine under various conditions pressure and flow rates. Diagrams of the turbine and the test equipment are provided. Data are presented in the form of tables and graphs. Photographs of the vortex flow generated by the turbine rotation are included. Mathematical models are developed to support the theoretical considerations. Transl. by P.N.F.

N74-13975# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
NUMERICAL PREDICTION OF THREE-DIMENSIONAL FLOWS
S. V. Patankar and D. B. Spalding Jun. 1972 29 p refs
(EF/TN/A/46) Avail: NTIS HC $3.50

A general calculation procedure for unsteady or steady three-dimensional flows with recirculation is described with all its features except the treatment of compressibility and free surfaces. The procedure is of the Eulerian finite-difference type, uses the velocity components and pressure as the dependent variables to determine the flow field, and employs a line-by-line procedure for the solution of the algebraic equations. As an illustration of the use of the procedure, calculations are presented for flows in a rectangular cavity, caused by the movement of a part of one wall. The significant features of the procedure are summarized and further research tasks are indicated. Author

N74-13976# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
PREDICTION OF MOMENTUM, HEAT AND MASS TRANSFER IN SWIRLING, TURBULENT BOUNDARY LAYERS
M. L. Kooslin, B. E. Launder, and B. I. Sharma Sep. 1973 30 p refs
(HTS/73/50) Avail: NTIS HC $3.50

The outcome of finite difference calculations of turbulent flow near spinning cones, discs and cylinders is presented. The turbulence model used is a version of the mixing length hypothesis in which the mixing length which would prevail in the absence of swirl is made a linear function of the local 'swirling flow' Richardson number. Agreement with available experimental data for these geometries is generally good. At high swirl rates, however, a few systematic differences between experiment and calculation become evident which are probably attributable to the nonisotropic nature of the effective viscosity in such complex strain fields. Author

N74-13977# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
MEASUREMENTS IN THE MACH 15 TURBULENT BOUNDARY LAYER ON THE WALL OF THE LONGSHOT CONICAL NOZZLE
Edgard Backx May 1973 25 p refs Presented at EUROMECH 43 Colloq. on Heat Transfer in Turbulent Boundary Layers with Variable Fluid Properties, Goettingen, West Germany, 14-16 May 1973
(VKI-Preprint-73-1) Avail: NTIS HC $3.25

Pitot pressure is measured across a Mach 15 turbulent boundary layer on the nozzle wall of the Longshot hypersonic piston-driven wind tunnel. An attempt is made to measure wall static pressure but only a qualitative result was obtained. Many difficulties were encountered to measure the total temperature since the flow running time is only 10 msecs and the free stream stagnation temperature is more than 1,700 K. The total temperature near the wall was measured with shielded chromel-alumel thermocouples made of 12.5 um diameter wires. A fine tungsten wire is used in the free stream and in the boundary layer. The temperature was estimated from the change in resistance of the wire. The results are presented without corrections for losses but possible corrections are discussed. Author

N74-13978# Kanner (Leo) Associates, Redwood City, Calif.
VELOCITY DEPENDENCE OF THE EFFICIENCY OF DEPOSITION OF AEROSOL PARTICLES ON FIBERS AND THE POSSIBILITY OF SEPARATING FACTORS IN THE FILTRATION PROCESS
L. V. Radushkevich and V. A. Kolganov Aug. 1973 14 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 41, no. 4, 1968 p 971-976 Sponsored by EPA
(APTIC-13752; TR-21-74) Avail: NTIS HC $3.00

An experimental study was made of the deposition of polydisperse aerosols on polystyrene with near spherical particles of 0.1 to 0.6 microns on individual fibers with a mean diameter

of 4.3 microns. The flow rates were from 0.05 to 15.0 centimeters per second. The experiments established that at low flow rates, diffusional deposition of these particle sizes is usually complicated by the effect of tangency, and only for particles of about 0.1 microns does pure diffusion without tangency occur. At high flow rates, the regime of pure tangency without diffusional deposition is possible, beginning at flow rates of about 10 to 15 centimeters per second when the efficiency rises linearly with particle size. Author

N74-13979*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL WAKE SURVEY BEHIND VIKING 75 ENTRY VEHICLE AT ANGLES OF ATTACK OF 0 DEG, 5 DEG, AND 10 DEG, MACH NUMBERS FROM 0.20 TO 1.20, AND LONGITUDINAL STATIONS FROM 1.50 TO 11.00 BODY DIAMETERS
Clarence A. Brown, Jr. and James F. Campbell Washington Nov. 1973 204 p refs
(NASA-TM-X-2830; L-9010) Avail: NTIS HC $5.50 CSCL 20D

An investigation was conducted to obtain flow properties in the wake of a preliminary configuration of the Viking '75 Entry Vehicle at Mach numbers from 0.20 to 1.20 and at angles of attack of 0 deg, 5 deg, and 10 deg. The wake flow properties were calculated from total and static pressures measured with a pressure rake at longitudinal stations varying from 1.50 to 11.00 body diameters, and are presented in tabulated and plotted form. The wake properties were essentially symmetrical about the X-axis at alpha = 0 deg and the profiles were shifted away from the X-axis at angles of attack. An unexpected reduction in wake property ratios occurred as the Mach number increased from 0.60 to 1.00; these ratios then increased as the Mach number increased to 1.20. The reduction was present for all the longitudinal stations of the tests and decreased with increased longitudinal distance. Author

N74-13980# Ernst-Mach-Inst., Freiburg (West Germany).
THEORY AND MEASUREMENTS OF SHOCK WAVES IN A CHANNEL WITH A PERPENDICULAR BRANCH [ZUR AUSBREITUNG VON STOSSWELLEN IN EINEM KANAL MIT RECHTWINKLIGER ABZWEIGUNG THEORIE UND MESSUNGEN]
Werner Heilig Dec. 1972 38 p refs In GERMAN; ENGLISH summary
(Rept-6/72) Avail: NTIS HC $4.00

A channel with rectangular cross-section is considered at which a branch of the same cross-section is fixed perpendicularly. The Primary shock diffracted at the first corner is calculated after Whitham's theory. This curved shock splits up into two parts, one of which continues, whereas the other one penetrates the branch. The intensity of each part after having steepened to a plane shock is found using the law of conservation of energy. Results of calculation are compared with measurements. Author (ESRO)

N74-13981# Technischen Universitaet, Munich (West Germany). Lab. fuer Reaktorregelung und Anlagensicherung.
DETERMINATION AND APPROXIMATION OF CRITICAL MASS FLOW RATES
P. Schally Mar. 1973 64 p refs In GERMAN; ENGLISH summary
(MRR-119) Avail: AEC Depository Libraries HC $5.25

To predict critical mass flow rates the model of Moody and the homogeneous equilibrium model are often used. The derivation, the numerical calculation, and the approximation of the critical mass flow rates to predict them with the aid of the above mention models are discussed. The coefficients necessary for calculation of the mass flow rates are given in connection with the appropriate functions. Author (NSA)

N74-13982# Columbia Univ., New York.
NUMERICAL STUDIES OF SHOCK FOCUSING IN A COAXIAL ELECTROMAGNETIC SHOCK TUBE Ph.D. Thesis
Hung Chang Lui 1973 157 p refs
(Contract AT(11-1)-3086)
(COO-3086-19) Avail: NTIS HC $10.00

The generation of a strong transverse MHD shock wave in a coaxial electromagnetic shock tube is simulated numerically. Further plasma heating is achieved by shock reflection and focusing on the end wall. The details of the two-dimensional axisymmetric flow in the shock tube and the process of shock focusing and reflection from a curved end wall are studied. In general, the drive currents can be arbitrary functions of time, and the end wall can be of arbitrary shape. The scheme used is the fluid-in-cell method (FLIC), modified for compressible, time-dependent magnetohydrodynamic flows to include a magnetic field perpendicular to the flow directions. The governing equations are the two-dimensional axisymmetric, ideal single fluid MHD equations coupled with Maxwell's equations. Finite differencing is carried out for cells of variable shapes to accommodate solid walls and free surfaces. On a moving vacuum-plasma interface, a mixed Lagrangian-Eulerian procedure is used. NSA

N74-13983# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
A THEORETICAL INVESTIGATION OF AXISYMMETRIC SUBSONIC DIFFUSER FLOW Technical Report, Jun. 1972 - Apr. 1973
Kerwyn D. Mach Jul. 1973 72 p refs
(AF Proj. 3066)
(AD-767895; AFAPL-TR-73-40) Avail: NTIS CSCL 20/4

A marching procedure for solving the finite difference equations describing inviscid, subsonic, compressible flow in an axisymmetric duct is described. The concept of artificial viscosity is introduced and special provisions for maintaining continuity are included. The method predicts the pressure and velocity distributions at any axial station in the duct. A computer program and several sample results are also presented and discussed. Author (GRA)

N74-13984# Martin Marietta Corp., Baltimore, Md.
THREE-DIMENSIONAL LAMINAR BOUNDARY LAYER OVER BODY OF REVOLUTION AT INCIDENCE. PART 7: THE EXTREMELY HIGH INCIDENCE CASE
K. C. Wang Jul. 1973 45 p refs
(Contract F44620-70-C-0085; AF Proj. 9749)
(AD-767764; MML-TR-73-08C-Pt-7; AFOSR-73-1265TR-Pt-7)
Avail: NTIS CSCL 20/4

The report presents results of exact, full three-dimensional solutions of the incompressible laminar boundary layer over a prolate spheroid at an extremely high incidence. In contrast to the high incidence (30 degrees) case recently reported, this extremely high incidence (45 degrees) problem is characterized by features reflecting the predominance of the circumferential flow over the meridional flow and, more importantly, by a closed, rather than an open, separation pattern. These features include much larger circumferential skin friction than meridional skin friction and that the limiting streamlines are more closely oriented along the parallels. Author (GRA)

N74-13985# Naval Research Lab., Washington, D.C.
NONLINEAR DEVELOPMENT OF THE RAYLEIGH-TAYLOR INSTABILITY IN THE SHALLOW-WATER APPROXIMATION Interim Report
D. L. Book, Edward Ott (Cornell Univ., Ithaca, N. Y.), and A. L. Sulton (Sci. Appl., Inc., Alexandria, Va.) Sep. 1973 22 p refs
(AD-768296; NRL-MR-2642) Avail: NTIS CSCL 20/4

The nonlinear evolution of the Rayleigh-Taylor instability in the long wavelength limit is investigated for an incompressible fluid supported against gravity (or inertial forces) by a massless fluid and bounded above by a rigid wall. Shallow water approximation permits a solution for the motion of the interface without reference to the detailed motion of fluid in the interior. (Modified author abstract) GRA

N74-13986# Naval Ship Research and Development Center, Bethesda, Md.
WALL SHEAR STRESS AND MEAN-VELOCITY MEASUREMENTS IN A THREE DIMENSIONAL TURBULENT BOUNDARY LAYER
John L. Power Sep. 1973 48 p refs
(AD-768297; NSRDC-4056) Avail: NTIS CSCL 20/4

A three-dimensional smooth wall turbulent boundary layer with a moderate adverse pressure gradient was produced on

the floor of a wind tunnel. The boundary layer velocity profile was measured at two positions, using a three-tube pressure probe. The streamwise, skin-friction coefficient was calculated with the skin-friction laws of Granville and Ludwieg and Tillmann using experimentally obtained boundary layer parameters. The results were compared with skin-friction coefficients obtained by using Preston tubes. (Modified author abstract) GRA

N74-13987# ARO, Inc., Arnold Air Force Station, Tenn.
WALL TEMPERATURE EFFECTS ON TWO- AND THREE-DIMENSIONAL TRANSONIC TURBULENT BOUNDARY LAYERS Final Report, Dec. 1972 - Jul. 1973
J. C. Adams, Jr. and A. W. Mayne, Jr. AEDC Oct. 1973 71 p refs
(ARO Proj. VD05; ARO Proj. VF405)
(AD-767900; ARO-VKF-TR-73-100; AEDC-TR-73-156) Avail: NTIS CSCL 20/4

Wall temperature effects on two- and three-dimensional high Reynolds number turbulent boundary layers are examined for representative high Reynolds number tunnel (HIRT) conditions relative to flight; also considered are hot-wall conditions relative to space shuttle subsonic and transonic flight during earth entry. Results show significant influences of wall-to-stagnation temperature ratio on the location of boundary-layer separation and the friction drag coefficient. The study also indicates how rapid model wall temperature during a typical testing period of 2 to 10 sec may be undesirable for HIRT testing since unsteady aerodynamic phenomena can be influenced by rapidly changing turbulent boundary-layer wall temperature levels. (Modified author abstract) GRA

N74-13988# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW AND HEAT TRANSFER DURING THE INJECTION OF COOLANTS INTO A SUPERSONIC FLOW
V. N. Kharchenko 27 Sep. 1973 11 p refs Transl. into ENGLISH from Tr. Akad. Nauk Belorussk. Inst. Teplo- i Massoobmena (Minsk), v. 1, 1972 p 296-300
(AF Proj. G101)
(AD-767940; FTD-HT-23-35-74) Avail: NTIS CSCL 20/4

Some information is presented on the results of an experimental study of the flow and heat transfer on the surface of sharp circular cones with 10 deg half-angle and base diameter of 80 mm with the injection of the air or helium through a slit along the smooth cone surface and also through slits or permeable sections established in circular recesses of varied length and depth. The tests were made at Mach number 5, stagnation temperature 250C, and stagnation pressure 8 bar. GRA

N74-13989# ARO, Inc., Arnold Air Force Station, Tenn.
A METHOD FOR THE PREDICTION OF THE EFFECTS OF FREE-STREAM DISTURBANCES ON BONDARY-LAYER TRANSITION Final Report, Jan. 1972 - Mar. 1973
J. A. Benek and M. D. High AEDC Oct. 1973 28 p refs
(ARO Proj. PW3101; ARP Proj. PW5201)
(AD-767899; ARO-PWT-TR-73-88; AEDC-TR-73-158) Avail: NTIS CSCL 20/4

A semiempirical expression for boundary-layer transition location is developed based on the concept of a critical ratio of inertial to viscous shearing stresses at laminar breakdown. Extensive comparisons between predicted and measured transition locations on a 10-deg included-angle cone at transonic speeds are shown with the data predicted to within 10%. Comparisons are also made with low subsonic and supersonic data which indicate the method is extendible to these flow regimes.
Author (GRA)

N74-13990# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF HEAT EXCHANGE ON A ROUGH PLATE
V. N. Kryukov and V. P. Solntsev 18 Sep. 1973 10 p refs Transl. into ENGLISH from Tr. Akad. Nauk Belorussk. SSR, Inst. Teplo- i Massoobmena (Minsk), v. 1, 1972 p 57-61
(AF Proj. G101)
(AD-767996; FTD-HT-23-28-74) Avail: NTIS CSCL 20/4

There are times in practice when one has to deal with flow past rough surfaces in the presence of heat exchange. However, relatively few works have been devoted to studying the effect of roughness on heat exchange with external flow. The aim of this study is to obtain and analyze data on heat exchange on a rough plate, under conditions when complete roughness is encountered as well as in the area of transitional conditions.
GRA

N74-13991# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
INTERACTION OF TWO PERPENDICULAR BOUNDED JETS
Y. S. Cha and J. A. Owczarek Aug. 1973 185 p refs
(Contract N00014-69-A-0417)
(AD-767668; THEMIS-LU-TR-17) Avail: NTIS CSCL 20/4

The interaction of two incompressible, turbulent bounded jets was investigated experimentally by using hot wire technique. Detailed measurements of velocity in the interaction zone and farther downstream were made for different values of setback, width of the control jet nozzle and control jet total pressure. Turbulence intensity profiles across the jet for various distances downstream from the stronger (power) jet nozzle exit are also reported. Angles of deflection of the power jet were determined experimentally. Two analytical fluid models were used in predicting the angle of deflection. (Modified author abstract)
GRA

N74-13992# ARO, Inc., Arnold Air Force Station, Tenn.
CALCULATION OF THE BOUNDARY-LAYER FLOW IN THE WINDWARD SYMMETRY PLANE OF A SPHERICALLY BLUNTED AXISYMMETRIC BODY AT ANGLE OF ATTACK, INCLUDING STREAM LINE-SWALLOWING EFFECTS Final Report, Sep. 1971 - Dec. 1972
Arloe W. Mayne, Jr. AEDC Oct. 1973 57 p refs
(ARO Proj. VW5206; ARO Proj. VF203)
(AD-768340; ARO-VKF-TR-73-102; AEDC-TR-73-166) Avail: NTIS CSCL 20/4

Three-dimensional compressible boundary-layer equations are particularized to the windward symmetry plane of a spherically blunted axisymmetric body at incidence under hypersonic conditions. Through the use eddy transport and streamwise intermittency both transitional and fully turbulent boundary layers may be treated. A scheme is presented for determining the outer-edge boundary conditions based on a mass flow balance treatment of the boundary-layer entrainment of the inviscid flow. A finite-difference technique is described for solving the set of partial differential equation governing the boundary-layer flow, and for treating the streamline-swallowing phenomenon. GRA

N74-13993# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
DESIGN OF A NEAR OPTIMAL FLUIDIC OPERATIONAL AMPLIFIER
F. T. Brown, J. S. Boparai, and T. M. Skeikh Jun. 1973 86 p refs
(Contract N00014-69-A-0417; Proj. Themis)
(AD-767667; THEMIS-LU-TR-16) Avail: NTIS CSCL 13/7

Traditional design of fluidic operational amplifiers places the loop filter, necessary for stability, in the feedback path. One consequence is severe saturation of the forward-loop high-gain amplifier for all except low frequency or very small amplitude input signals, producing very low effective break frequency. Using optimal control concepts a design was evolved employing, instead, forward-loop filtering. The forward-loop amplifier chosen, a five-stage proportional amplifier has a nearly constant gain for a broad band of frequencies. The optimal design which assumes this characteristic has, theoretically, neglecting certain inevitable dissipative and inertive effects, no transient saturation at all to step changes in the input, and a response which is theoretically ideal. The filters contain closed-end resonant cavities. (Modified author abstract) GRA

N74-13994# Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
ROUND HORIZONTAL THERMAL-BUOYANT JET IN A CROSS FLOW
Ronald E. Nece and John D. Littler Jun. 1973 66 p refs
(PB-223376/5; TR-34W73-14212; OWRR-A-056-WASH(1))
Avail: NTIS HC $3.50 CSCL 20D

Results are presented for an experimental study of round

buoyant jets discharged horizontally into and at right angles to the direction of flow of an unstratified receiving stream. Objectives were to obtain empirical relationships defining the trajectory and near field temperature distribution of such jets. Experimental results are given in the form of dimensionless jet trajectories and center-line temperature elevation above that of the receiving fluid. Experimental data were obtained for jet densimetric Froude numbers. Velocity ratios and Froude numbers tested span ranges commonly encountered in outfall designs. Experimental parameters, including boundary conditions with the jet being discharged from a circular outfall located close to the bottom of the receiving channel, were intended to be representative of simplified approximations of a single-outfall cooling water discharge from a thermal plant located on a river. GRA

N74-14668 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 1: FLUID MECHANICS [FACHGEBIET 1: STROEMUNGSMECHANIK]
In its DFVLR Annual Review, 1972 1972 p 3-93 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N74-13995 Uppsala Ionospheric Observatory (Sweden).
ENERGETIC PARTICLE FLUX AND ION AND ELECTRON DENSITY DISTRIBUTION BELOW 105 KM DURING AURORA
H. Derblom, L. Ladell, and W. Stoffregen 1971 61 p refs (FOA-3-A-3757-E2; Rept-17-Pt-A) Copyright. Avail: Issuing Activity

The properties of the D-region during different auroral situations, which are accompanied by absorption and geomagnetic activity, were investigated using rocket soundings, and ground based observations. The conditions during the experiment, the electron density and collision frequency are discussed along with ion density and mobility, and the energetic-electron flux. The relations between and electron density, and between energetic-electron flux and electron density are also discussed. F.O.S.

N74-13996 Cincinnati Univ., Ohio.
THE RESPONSE OF THE IONOSPHERIC F-LAYER TO ATMOSPHERIC GRAVITY WAVES AND ASSOCIATED AIRGLOW PHENOMENA Ph.D. Thesis
Hayden Samuel Porter, Jr. 1973 114 p
Avail: Univ. Microfilms Order No. 73-24841

A fully time dependent analytical treatment is developed of F-layer response to disturbances arising either through momentum transfer from the neutral constituents or through ion pair production or loss mechanisms. The ion equation of motion, including an ion drag term, and the ion continuity equation, including a linear loss term and an arbitrary ion pair production term, are solved simulataneously using Green's function and integral equation methods. It is assumed that typical horizontal scales for variations in the disturbance are large in comparison to the vertical half width of the F-layer, so that a description using only one spatial dimension is applicable. It is also assumed that the disturbance is sufficiently varying in time that quasistatic equilibrium holds in the ion equation of motion. Dissert. Abstr.

N74-13997 Houston Univ., Tex.
AN ANALYSIS OF THE OPTICAL AND ELECTROMAGNETIC PROPERTIES OF GRAVITATIONAL FIELDS IN GENERAL RELATIVITY Ph.D. Thesis
Ronald Tobias Borochoff 1973 103 p
Avail: Univ. Microfilms Order No. 73-22893

From first principles of electromagnetism, a formalism analogous to that of classical optics is developed for an analysis of stationary metric fields as optical media. In the geometric approximation, stationary metrics are shown to generate Fresnel surfaces without centers of inversion; it is shown that no material free gravitational field can display birefringence, nor can it generate a forced birefringence, of a relativistic nature, in isotropic material introduced into the field. For the ray path, the Frenet triad, the curvature and the torsion are all calculated both for an arbitrary weak field and a spatially isotropic strong field; also, at the same approximation level, the equation for the deflection of the ray path is given for the above two metric classes. At the next level of approximation, the transport equation for the vector fields is presented. This equation demonstrates that a polarization rotation exists for certain metric fields. Dissert. Abstr.

N74-13998 Rice Univ., Houston, Tex.
OBSERVATIONS OF ARTIFICIALLY INDUCED ENHANCEMENTS IN THE IONOSPHERIC BACKSCATTER SPECTRUM Ph.D. Thesis
Luiz Alberto Vieira 1973 133 p
Avail: Univ. Microfilms Order No. 73-21547

The Arecibo heating experiments consisted of sending high frequency radio waves to the ionosphere and studying the variations in the ionospheric magnetoplasma. The HF transmitter (heater) was capable of sending waves in the frequency range from 5 to 12 MHz with power up to 140 kW in continuous wave. It was found that the spectrum of the echo contained HF-enhanced lines at frequencies near the electron cyclotron frequency and the second harmonic of the plasma frequency in addition to the enhancements previously observed in the ion and plasma lines. Turning the heater off the newly detected lines were no longer observed, indicating that the enhancements were due to the effect of the HF waves in the medium. The line enhancements were observed at an altitude near the reflection height of the HF waves, which was typically in the F-region.
Dissert. Abstr.

N74-13999 Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE DEVELOPMENT OF A STOCHASTIC MODEL OF THE ATMOSPHERE BETWEEN 30 AND 90 km TO BE USED IN DETERMINING THE EFFECT OF ATMOSPHERIC VARIABILITY ON SPACE SHUTTLE ENTRY PARAMETERS Ph.D. Thesis
Janet White Campbell 1973 152 p
Avail: Univ. Microfilms Order No. 73-23440

A stochastic model of the atmosphere between 30 and 90 km was developed for use in Monte Carlo space shuttle entry studies. The model is actually a family of models, one for each latitude-season category. Each latitude-season model generates a pseudo-random temperature profile. The standard deviation of temperature at each altitude for a given latitude-season model is estimated from sounding rocket data. Departures from the mean temperature at each altitude are produced by assuming a linear regression of temperature on the solar heating rate of ozone. A profile of random ozone concentrations is first generated using an auxiliary stochastic ozone model, also developed as a part of this study, and then solar heating rates are computed for the random ozone concentrations.
Dissert. Abstr.

N74-14000 Washington Univ., Seattle.
LIGHT ABSORPTION BY ATMOSPHERIC AEROSOL AND ITS GLOBAL CLIMATIC IMPLICATIONS Ph.D. Thesis
Chin-I Lin 1973 91 p
Avail: Univ. Microfilms Order No. 73-22587

Radiative absorption by aerosol particles is very small yet important compared to other contributions to light extinction in the atmosphere. A study of various approaches indicates that concentrating the aerosol provides the simplest and most feasible means for measuring aerosol light absorption. An advantageous method for the measurement of b sub abs is developed and discussed. The method uses a piece of opal glass to integrate light scattered by aerosol particles collected on Nuclepore filters. Analysis shows that values of the aerosol absorption coefficient measured by the opal glass method are accurate to well within an order of magnitude. Calculated values of the imaginary part of aerosol refractive index suggest that man's influence on the temperature of the atmosphere earth system is in the ambiguous range but with a slight tendency to favor global heating.
Dissert. Abstr.

N74-14001 Pennsylvania State Univ., University Park.
PROPAGATION STUDIES USING A THEORETICAL IONOSPHERIC MODEL Ph.D. Thesis
Myung Ki Lee 1973 148 p
Avail: Univ. Microfilms Order No. 73-24019

The currently available mid-latitude ionospheric and neutral atmospheric models are coupled with an advanced three dimensional ray tracing program to see what success would be obtained in predicting the wave propagation conditions and to study what extent the use of theoretical ionospheric models is practical. The Penn State Mk 1 ionospheric model, the Mitra-Rowe D region model, and the Groves' neutral atmospheric model are used to best represent the real electron densities and collision frequencies. The Faraday rotation and differential Doppler velocities from satellites, the propagation modes for long distance high frequency propagation, the group delays for each mode the ionospheric absorption, and the spatial loss are all predicted.
Dissert. Abstr.

N74-14002 Rice Univ., Houston, Tex.
ELECTRIC CURRENTS ASSOCIATED WITH AN AURORAL ARC Ph.D. Thesis
Bill Roy Sandel 1973 280 p
Avail: Univ. Microfilms Order No. 73-21594

An experiment to investigate the nature of electric currents related to an aurora has been performed. A sounding rocket payload comprising a vector magnetometer and an array of charged particle detectors was launched from Poker Flat Rocket Range, Alaska at 2217 local time on 13 February 1971. The vehicle (NASA 18.110) attained an apogee altitude of 210 km over two relatively stable homogeneous arcs of about 8 kR intensity. The particle detector data showed that in the downward current precipitating electrons in the energy range 1-2 keV carried a current directed opposite to and a factor of 5-10 smaller than the current inferred there from the magnetometer data. A visible arc associated with each sheet current confirmed the presence of precipitating electrons in both current sheets. However, the upward field-aligned current was found to extend at least 20-30 km to the north of the precipitating energetic particles as defined by the auroral luminosity. Dissert. Abstr.

N74-14003 Pennsylvania State Univ., University Park.
MODEL STUDIES OF THE LOWER IONOSPHERE Ph.D. Thesis
John Norman Rowe 1973 213 p
Avail: Univ. Microfilms Order No. 73-24039

A summary of quiet D-region electron density measurements made by the wave interaction technique is presented. The mean electron density profile for July, 1970 noon and the measured relative positive ion composition are used as constraints to develop a model of D-region ion chemistry between 60 and 80 kilometers. The neutral densities were taken from previous experimental and theoretical studies. Electron production rates due to Lyman-alpha, ultraviolet, X-rays, and galactic cosmic rays were considered. Some estimates are reported of the rate of conversion of NO(+) ions into water cluster ions, the NO density and the detachment rate. It is concluded that the model developed for summer noon conditions will predict reasonably well the average seasonal and diurnal behavior of the D-region electron density.
Dissert. Abstr.

N74-14004 RAND Corp., Santa Monica, Calif.
THE COASTAL ZONE: PROBLEMS WITH MAN'S USES
Charles Todd Sep. 1973 13 p refs
(P-5081) Copyright. Avail: Issuing Activity

Because of the attraction the coast creates, man's impact is heavily felt through his use of these regions. Man's uses include harvesting food, living space, recreation, industrial (power production), commercial (development), and waste disposal. In 1971 alone, the U.S. harvested nearly 5 billion pounds of fish and this figure does not include harvesting by foreign vessels in U.S. coastal waters. Also urban and industrial activities place pressures on these highly productive areas. Author

N74-14005 Alaska Univ., College.
THE RELATIONSHIP OF AURORAL HYDROGEN EMISSION TO AURORAL MORPHOLOGY Ph.D. Thesis
William John Stringer 1973 194 p
Avail: Univ. Microfilms Order No. 73-23785

During the winters of 1964-65 and 1965-66 a north-south chain of meridian scanning photometers was operated in Alsaka along the dipole 256 deg meridian effectively gathering auroral spectral photometric data between dipole latitudes 60 and 75 deg. The analysis of auroral H-beta and N(2+) 4278 A MSP measurements are representative of precipitation of energetic protons and electrons is presented. In order to illustrate the conclusions, plots of zenith intensity from dipole latitude 60 to 75 deg of H-beta and N(2+) 4278 A were prepared for every fifteen minutes during the night of January 20/21, 1966. When examined in terms of the auroral substorm model, it is found that the most predictable feature of the aurora is the hydrogen arc. Dissert. Abstr.

N74-14006*# California Univ., Berkeley. Space Sciences Lab.
AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Annual Progress Report
Robert N. Colwell, C. West Churchman, Robert H. Burgy, Gerald Schubert, John E. Estes, Leonard W. Bowden, R. Algazi, and K. L. Coulson, Principal Investigators 30 Jun. 1973 402 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Grant NGL-05-003-404)
(E74-10136; NASA-CR-136181) Avail: NTIS HC$22.25 CSCL 08F

The University of California has been conducting an investigation which seeks to determine the usefulness of modern remote sensing techniques for studying various components of California's earth resources complex. Most of the work has concentrated on California's water resources, but with some attention being given to other earth resources as well and to the interplay between them and California's water resources. For individual titles, see N74-14007 through N74-14014.

N74-14007* California Univ., Berkeley. Social Sciences Group.
DEFINITION OF EARTH RESOURCE POLICY AND MANAGEMENT PROBLEMS IN CALIFORNIA
Robert N. Colwell, C. West Churchman, Principal Investigators, Ida Hoos, and William Gotcher *In its* An Intergrated Study of Earth Resources in the State of California Using Remote Sensing Techniques 30 Jun. 1973 12 p refs ERTS (For availability see N74-14006 05-13)
CSCL 05B

There are no author-identified signficant results in this report.

N74-14008* California Univ., Davis. Dept. of Water Science and Engineering.
USER REQUIREMENTS FOR THE APPLICATION OF REMOTE SENSING IN THE PLANNING AND MANAGEMENT OF WATER RESOURCE SYSTEMS
Robert N. Colwell, Principal Investigators and Robert H. Burgy *In its* An Integrated Study of Earth Resources in the State of California Using Remote Sensing Techniques 30 Jun. 1973 9 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (For availability see N74-14006 05-13)
CSCL 08H

There are no author-identified significant results in this report.

N74-14009* California Univ., Berkeley. Forestry Remote Sensing Lab.
REMOTE SENSING DATA AS AN AID TO RESOURCE MANAGEMENT IN NORTHERN CALIFORNIA
Robert N. Colwell, Principal Investigator, Gene A. Thorley, Andrew S. Benson, David M. Carneggie, William C. Draeger, Paul F. Krumpe, Donald T. Lauer, James D. Nichols, Howard O. Thrall, Randall W. Thomas et al *In its* An Integrated Study of Earth Resources in the State of California Using Remote Sensing Techniques 30 Jun. 1973 92 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

ERTS (For availability see N74-14006 05-13)
CSCL 08B

There are no author-identified significant results in this report.

N74-14010* California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
RIVER MEANDER STUDIES
Robert N. Colwell, Gerald Schubert, Principal Investigators, and Richard E. Lingenfelter *In its* An Integrated Study of Earth Resources in the State on California Using Remote Sensing Techniques 30 Jun. 1973 26 p refs ERTS (For availability see N74-14006 05-13)
CSCL 08H

There are no author-identified significant results in this report.

N74-14011* California Univ., Santa Barbara. Geography Remote Sensing Unit.
ASSESSMENT OF RESOURCES IN THE CENTRAL REGIONAL TEST SITE
Robert N. Colwell, John E. Estes, Principal Investigators, Leslie W. Senger, Randolph R. Thaman, Steven Kraus, Kris Bjorklund, Dal Cottrell, Don Brunelle, Betsy Palmer, and Rick Hoffman *In its* An Integrated Study of Earth Resources in the State of California Using Remote Sensing Technqiues 30 Jun. 1973 64 p refs ERTS (For availability see N74-14006 05-13)
CSCL 08G

There are no author-identified signficant results in this report.

N74-14012* California Univ., Riverside. Dept. of Geography.
ENVIRONMENTAL MONITORING AND ASSESSMENT IN SOUTHERN CALIFORNIA USING REMOTE SENSING TECHNIQUES
Robert N. Colwell, Leonard W. Bowden, Principal Investigators, J. B. Bale, C. W. Johnson, J. Viellenave, D. Goehring, P. Wilke, V. Coleman, J. Huning, C. Hutchinson et al *In its* An Integrated Study of Earth Resources in the State of California Using Remote Sensing Techniques 30 Jun. 1973 139 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (For availability see N74-14006 05-13)
CSCL 08B

There are no author-identified significant results in this report.

N74-14013* California Univ., Davis. Dept. of Electrical Engineering and Computer Sciences.
DIGITAL HANDLING AND PROCESSING OF REMOTE SENSING DATA
Robert N. Colwell, R. Algazi, Principal Investigators, D. J. Sakrison, J. Schriebman, W. Dere, B. Romberger, and A. Samulon *In its* An Integrated Study of Earth Resources in the State of California Using Remote Sensing Techniques 30 Jun. 1973 25 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (For availability see N74-14006 05-13)
CSCL 05B

There are no author-identified signficant results in this report.

N74-14014* California Univ., Davis. Dept. of Agricultural Engineering.
INVESTIGATION OF ATMOSPHERIC EFFECTS IN IMAGE TRANSFER
Robert N. Colwell, K. L. Coulson, Principal Investigators, and R. L. Walraven *In its* An Integrated Study of Earth Resources in the State of California Using Remote Sensing Techniques 30 Jun. 1973 26 p Original contains color illustration. ERTS (For availability see N74-14006 05-13)
CSCL 04A

There are no author-identified significant results in this report.

N74-14015*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
SKYLAB SHORT-LIVED EVENT ALERT PROGRAM Quarterly Progress Report, 1 Aug. - 31 Oct. 1973
Robert A. Citron, Principal Investigator Nov. 1973 4 p EREP
(Contract NAS9-13474)
(E74-10147; NASA-CR-136185; QPR-2) Avail: NTIS HC $3.00 CSCL 22C

There are no author-identified significant results in this report.

N74-14016*# TRW Systems Group, Redondo Beach, Calif.
EVALUATION OF DIGITAL CORRECTION TECHNIQUES FOR ERTS IMAGES Bimonthly Progress Report, Nov. - Dec. 1973
J. E. Taber, Principal Investigator and S. S. Rifman 3 Jan. 1974 3 p ref ERTS
(Contract NAS5-21814)
(E74-10148; NASA-CR-136207) Avail: NTIS HC $3.00 CSCL 05B

There are no author-identified significant results in this report.

N74-14017*# Wolf Research and Development Corp., Riverdale, Md.
THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN CENTRAL NORTH AMERICA Interim Report, Jun. - Nov. 1973
Allan J. Jelacic, Principal Investigator Dec. 1973 34 p refs ERTS
(Contract NAS5-21761)
(E74-10149; NASA-CR-136208; IR-3) Avail: NTIS HC $3.75 CSCL 08L

The author has identified the following significant results. A comparison of lake freeze transition zone migration with the movement of large pressure centers reveals the following consistencies: (1) polar centinental cyclones originate within and/or travel along the trend of the transition zone; (2) polar continental anticyclones fail to cross the transition zone; (3) polar outbreak anticyclones pass through the transition zone, apparently unaffected. In addition, storm centers associated with the transition zone undergo significant intensification manifest by a deepening of the pressure through and increased precipitation outside the zone.

N74-14018*# Environmental Research Inst. of Michigan, Ann Arbor.
DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Progress Report, Nov. 1973
Richard F. Nalepka and William A. Malila, Principal Investigators 10 Dec. 1973 2 p EREP
(Contract NAS9-13280)
(E74-10150; NASA-CR-136209; ERIM-101900-19-L; MPR-9) Avail: NTIS HC $3.00 CSCL 05B

There are no author-identified significant results in this report.

N74-14019*# Alaska Univ., Fairbanks. Inst. of Water Resources.
BREAK-UP CHARACTERISTICS OF THE CHENA RIVER WATERSHED, CENTRAL ALASKA Interim Scientific Report, Nov. 1973
Robert F. Carlson, Principal Investigator, Gerd Wendler, and Doug Kane 1 Dec. 1973 12 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21833)
(E74-10151; NASA-CR-136210) Avail: NTIS HC $3.00 CSCL 08H

The author has identified the following significant results. The snow melt for a small watershed (5130 sq km) in Central Alaska was successfully monitored with ERTS-1 imagery. Aerial photography was used as supporting data for periods without satellite coverage. Comparison both with actual measurements and with a computer model showed good agreement.

N74-14020*# Bureau of Sport Fisheries and Wildlife, Jamestown, N.D. Northern Prairie Wildlife Research Center.
UTILIZATION OF SKYLAB (EREP) SYSTEM FOR APPRAIS-

ING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT Progress Report, Dec. 1973
Harvey K. Nelson, Principal Investigator Dec. 1973 2 p EREP
(NASA Order T-4114-B)
(E74-10152; NASA-CR-136211) Avail: NTIS HC $3.00 CSCL 06C
There are no author-identified significant results in this report.

N74-14021*# Environmental Research and Technology, Inc., Lexington, Mass.
STUDY TO DEVELOP IMPROVED SPACECRAFT SNOW SURVEY METHODS USING SKYLAB/EREP DATA Quarterly Progress Report, 15 Sep. - 15 Dec. 1973
James C. Barnes, Principal Investigator 15 Dec. 1973 5 p EREP
(Contract NAS9-13305)
(E74-10153; NASA-CR-136223; P-412-5; QPR-3) Avail: NTIS HC $3.00 CSCL 08L
There are no author-identified significant results in this report.

N74-14022*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF TIME LAPSE DATA PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS Progress Report, 7 Nov. 1973 - 6 Jan. 1974
Sidney M. Serebreny, Principal Investigator 7 Jan. 1974 5 p ERTS
(Contract NAS5-21841)
(E74-10154; NASA-CR-136281) Avail: NTIS HC $3.00 CSCL 08H
There are no author-identified significant results in this report.

N74-14023*# National Environmental Satellite Service, Washington, D.C.
A CLOUD PHYSICS INVESTIGATION UTILIZING SKYLAB DATA Quarterly Progress Report, Oct. - Dec. 1973
John Alishouse, Herbert Jacobowitz, and David Wark, Principal Investigators Dec. 1973 4 p ref EREP
(NASA Order T-4715-B)
(E74-10155; NASA-CR-136282; QPR-3) Avail: NTIS HC $3.00 CSCL 04B
There are no author-identified significant results in this report.

N74-14024*# Geological Survey, Washington, D.C.
INVESTIGATION OF SKYLAB IMAGERY FOR APPLICATION TO THEMATIC MAPPING Quarterly Progress Report, 1 Aug. - 31 Oct. 1973
Doyle G. Smith, Principal Investigator 26 Nov. 1973 2 p EREP
(NASA Order T-4649-B)
(E74-10156; NASA-CR-136283) Avail: NTIS HC $3.00 CSCL 08B
There are no author-identified significant results in this report.

N74-14025*# Geological Survey, Reston, Va. National Center.
CARTOGRAPHIC EVALUATION OF SKYLAB-A S-192 SCANNER IMAGES Quarterly Progress Report, 1 Aug. - 31 Oct. 1973
John D. McLaurin, Principal Investigator 31 Oct. 1973 5 p EREP
(NASA Order T-4111-B)
(E74-10157; NASA-CR-136284) Avail: NTIS HC $3.00 CSCL 08B
There are no author-identified significant results in this report.

N74-14026*# Ghent Univ. (Belgium). Geological Inst.
RELATIONSHIP BETWEEN SNOW COVER AND DISCHARGE AND WATER QUALITY OF WATERSHEDS, ARDENNES (BELGIUM)
Rene Tavernier, Principal Investigator 15 Nov. 1973 5 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E74-10158; NASA-CR-136285) Avail: NTIS HC $3.00 CSCL 08H
There are no author-identified significant results in this report.

N74-14027*# New Mexico State Bureau of Mines and Mineral Resources, Socorro.
GEOLOGIC ANALYSIS AND EVALUATION OF ERTS-A IMAGERY FOR THE STATE OF NEW MEXICO Progress Report, 29 Oct. - 29 Nov. 1973
Frank E. Kottlowski, Principal Investigator 29 Nov. 1973 5 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21861)
(E74-10159; NASA-CR-136286) Avail: NTIS HC $3.00 CSCL 08G
There are no author-identified significant results in this report.

N74-14028*# Wolf Research and Development Corp., Pocomoke City, Md.
APPLICABILITY OF SKYLAB REMOTE SENSING FOR DETECTION AND MONITORING OF SURFACE MINING ACTIVITIES Quarterly Progress Report, 8 Sep. - 31 Dec. 1973
R. L. Brooks, Principal Investigator and J. D. Pennewell 28 Dec. 1973 6 p EREP
(Contract NAS9-13310)
(E74-10160; NASA-CR-136287; QPR-3) Avail: NTIS HC $3.00 CSCL 08I
There are no author-identified significant results in this report.

N74-14029*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
INVENTORY OF FOREST AND RANGELAND RESOURCES, INCLUDING FOREST STRESS Monthly Progress Report, 16 Oct. - 15 Nov. 1973
Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll, Principal Investigators 27 Nov. 1973 4 p EREP
(NASA Order T-4106-B)
(E74-10161; NASA-CR-136288; MPR-7) Avail: NTIS HC $3.00 CSCL 02F
There are no author-identified significant results in this report.

N74-14030*# Kansas Univ., Lawrence. Space Technology Center.
SKYLAB STUDY OF WATER QUALITY Progress Report, Sep. - Nov. 1973
H. L. Yarger, Principal Investigator and James R. McCauley Nov. 1973 4 p EREP
(Contract NAS9-13271)
(E74-10162; NASA-CR-136289) Avail: NTIS HC $3.00 CSCL 08H
There are no author-identified signficant results in this report.

N74-14031*# Boeing Co., Kent, Wash.
QUANTITATIVE DETERMINATION OF STRATOSPHERIC AEROSOL CHARACTERISTICS Monthly Report, Oct. 1973
David L. Tingey, Principal Investigator Oct. 1973 1 p EREP
(Contract NAS9-13303)
(E74-10163; NASA-CR-136290) Avail: NTIS HC $3.00 CSCL 04A
There are no author-identified signficant results in this report.

N74-14032*# Research Triangle Inst., Research Triangle Park, N.C.
[RADAR BACKSCATTERING AS A MEANS FOR MEASURING OCEAN SURFACE PARAMETERS USING S193 ALTIMETRY AND S190B PHOTOGRAPHY] Monthly Progress Report, Nov. 1973

Charles L. Britt, Jr., Principal Investigator 19 Dec. 1973 1 p EREP
(Contract NAS9-13304)
(E74-10164; NASA-CR-136291) Avail: NTIS HC $3.00 CSCL 08J

There are no author-identified significant results in this report.

N74-14033*# Delaware Univ., Newark.
DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS
Karl-Heinz Szekielda, Principal Investigator Jul. 1973 24 p EREP
(Contract NAS9-13344)
(E74-10165; NASA-CR-136292) Avail: NTIS HC $3.25 CSCL 08A

There are no author-identified significant results in this report.

N74-14034*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY Bimonthly Progress Report, 23 Oct. - 23 Dec. 1973
Duwayne M. Anderson, H. L. McKim, R. K. Haugen, L. W. Gatto, C. W. Slaughter, and T. Marlar, Principal Investigators 23 Dec. 1973 6 p refs ERTS
(NASA Order S-70253-AG)
(E74-10166; NASA-CR-136293; BMPR-7) Avail: NTIS HC $3.00 CSCL 08E

There are no author-identified significant results in this report.

N74-14035*# Iowa State Univ. of Science and Technology, Ames. Iowa Agriculture Experiment Station.
REMOTE SENSING IN IOWA AGRICULTURE Progress Report, period ending 31 Dec. 1973
John P. Mahlstede, Principal Investigator, R. E. Carlson, and Tom E. Fenton 4 Jan. 1974 3 p ERTS
(Contract NAS5-21839)
(E74-10167; NASA-CR-136294) Avail: NTIS HC $3.00 CSCL 02C

The author has identified the following significant results. Analysis of 1972 single-date coverage indicated that a complete crop classification was not attainable at the test sites. Good multi-date coverage during 1973 indicates that many of the problems encountered in 1972 will be minimized. In addition, the compilation of springtime imagery covering the entire state of Iowa has added a new dimension to interpretation of Iowa's natural resources. ERTS-1 has provided data necessary to achieve the broad synoptic view not attainable through other means. This should provide soils and crop researchers and land use planners a base map of Iowa. Granted and due to the resolution of ERTS-1, not all details are observable for many land use planning needs, but this gives a general and current view of Iowa.

N74-14036*# Army Construction Engineering Research Lab., Champaign, Ill.
EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 9 Jun. - 8 Dec. 1973
Ravinder K. Jain, Principal Investigator 8 Dec. 1973 21 p
Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70255-AG)
(E74-10168; NASA-CR-136295) Avail: NTIS HC $3.25 CSCL 08H

There are no author-identified significant results in this report.

N74-14037*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report
George D. Swanlund, Principal Investigator, L. Kirvida, and M. Cheung Dec. 1973 2 p ERTS
(Contract NAS5-21742)
(E74-10169; NASA-CR-136296) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N74-14038*# Naval Research Lab., Washington, D.C.
TERRAIN PROPERTIES AND TOPOGRAPHY FROM SKYLAB ALTIMETRY Monthly Progress Report, Nov. 1973
Allan Shapiro, Principal Investigator 7 Jan. 1974 1 p EREP
(NASA Order T-4716-B)
(E74-10170; NASA-CR-136297) Avail: NTIS HC $3.00 CSCL 08E

There are no author-identified significant results in this report.

N74-14039*# Agricultural Research Service, Weslaco, Tex. Citrus Insects Research.
A STUDY OF THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY/DISTRIBUTION OF HOST PLANTS Progress Report, 1-30 Sep. 1973
William G. Hart, Sammy J. Ingle, and M. R. Davis, Principal Investigators 30 Sep. 1973 2 p EREP
(NASA Order T-4109-B)
(E74-10171; NASA-CR-136298; PR-8) Avail: NTIS HC $3.00 CSCL 02C

There are no author-identified significant results in this report.

N74-14040*# Geological Survey, Bay Saint Louis, Miss.
THE HYDROLOGIC SIGNIFICANCE OF FAULTS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK Quarterly Progress Report, 1 Sep. - 30 Nov. 1973
Gerald K. Moore and Este F. Hollyday, Principal Investigators 11 Dec. 1973 4 p EREP
(NASA Order H-2810-B-DOI)
(E74-10172; NASA-CR-136299) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N74-14041*# California Univ., Berkeley. Space Sciences Lab.
AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA BASED ON ERTS-1 AND SUPPORTING AIRCRAFT DATA Progress Report
Robert N. Colwell, Donald T. Lauer, Robert H. Burgy, Gerald Schubert, John E. Estes, Leonard W. Bowden, Vidal Algazi, William E. Wildman, and Gordon L. Huntington, Principal Investigators 31 Dec. 1973 3 p refs ERTS
(Contract NAS5-21827)
(E74-10173; NASA-CR-136300; PR-6) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified signficant results in this report.

N74-14042*# Agricultural Research Service, Weslaco, Tex. Citrus Insects Research.
A STUDY OF THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY/DISTRIBUTION OF HOST PLANTS Progress Report, 1-31 Oct. 1973
William G. Hart, Sammy J. Ingle, and M. R. Davis, Principal Investigators 31 Oct. 1973 2 p EREP
(NASA Order T-4109-B)
(E74-10174; NASA-CR-136303; PR-9) Avail: NTIS HC $3.00 CSCL 02C

There are no author-identified significant results in this report.

N74-14043*# Prescott College, Ariz.
THE HYDROLOGY OF PREHISTORIC FARMING SYSTEMS IN A CENTRAL ARIZONA ECOTONE Quarterly Report, period ending 31 Dec. 1973
George J. Gumerman, Principal Investigator 3 Jan. 1974 6 p EREP
(Contract NAS9-13342)
(E74-10175; NASA-CR-136304) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified signficant results in this report.

N74-14044*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
IN SITU SPECTRORADIOMETRIC CALIBRATION OF EREP IMAGERY AND OCEANOGRAPHY OF BLOCK ISLAND SOUND Monthly Progress Report, Dec. 1973
Edward Yost, Principal Investigator 20 Dec. 1973 3 p EREP
(Contract NAS9-13308)
(E74-10177; NASA-CR-136306) Avail: NTIS HC $3.00 CSCL 08J

There are no author-identified significant results in this report.

N74-14045*# California Earth Science Corp., Santa Monica.
FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA Monthly Progress Report, Jan. 1974
Paul M. Merifield, Principal Investigator 5 Jan. 1974 2 p EREP
(Contract NAS2-7698)
(E74-10179; NASA-CR-136310; MPR-7) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N74-14046*# Earth Satellite Corp., Washington, D.C.
FACILITATING THE EXPLOITATION OF ERTS IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Bimonthly Progress Report, 1 Nov. - 31 Dec. 1973
Frank J. Wobber, Kenneth R. Martin, Principal Investigators, Roger V. Amato, and Thomas Leshendok 4 Jan. 1974 10 p ERTS
(Contract NAS5-21744)
(E74-10180; NASA-CR-136311) Avail: NTIS HC $3.00 CSCL 05B

The author has identified the following significant results. The procedure for conducting a regional geological mapping program utilizing snow-enhanced ERTS-1 imagery has been summarized. While it is recognized that mapping procedures in geological programs will vary from area to area and from geologist to geologist, it is believed that the procedure tested in this project is applicable over a wide range of mapping programs. The procedure is designed to maximize the utility and value of ERTS-1 imagery and aerial photography within the initial phase of geological mapping programs. Sample products which represent interim steps in the mapping formula (e.g. the ERTS Fracture-Lineament Map) have been prepared. A full account of these procedures and products will be included within the Snow Enhancement Users Manual.

N74-14047*# Bureau of Indian Affairs, Washington, D.C.
TIMBER RESOURCE INFORMATION SYSTEM Progress Report, 1 Jul. - 31 Oct. 1973
Arthur M. Woll, Principal Investigator 21 Nov. 1973 5 p ERTS
(NASA Order S-70243-AG-3)
(E74-10181; NASA-CR-136320) Avail: NTIS HC $3.00 CSCL 02F

There are no author-identified significant results in this report.

N74-14048*# Geological Survey, Reston, Va.
THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS Progress Report, 1 Sep. - 31 Oct. 1973
William R. MacDonald, Principal Investigator 1 Nov. 1973 4 p ERTS
(NASA Order S-70243-AG-2)
(E74-10182; NASA-CR-136321) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N74-14049*# Geological Survey, Washington, D.C.
OVERALL EVALUATION OF ERTS IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Sep. - 1 Nov. 1973
Alden P. Colvocoresses, Principal Investigator 13 Nov. 1973 2 p ERTS
(NASA Order S-70243-AG-2)
(E74-10183; NASA-CR-136322) Avail: NTIS HC $3.00 CSCL 08B

There are no author-identified significant results in this report.

N74-14050*# Geological Survey, Menlo Park, Calif.
PRINCIPAL SOURCES AND DISPERSAL PATTERNS OF SUSPENDED PARTICULATE MATTER IN NEARSHORE SURFACE WATERS OF THE NORTHEAST PACIFIC OCEAN Progress Report, 1 Apr. - 15 Nov. 1973
Paul R. Carlson, Principal Investigator and Richard J. Janda 15 Nov. 1973 12 p refs ERTS
(NASA Order S-70243-AG-7)
(E74-10186; NASA-CR-136325) Avail: NTIS HC $3.00 CSCL 08J

The author has identified the following significant results. Release-recovery paths of drift cards released in conjunction with ERTS-1 overflight show that nearshore surface currents along the central and northern California coast flowed southward at an average rate in excess of 10 cm/sec (8.5 km/day) during August and September 1973 (California Current). By the middle of October 1973, the nearshore surface currents had reversed and the dominant flow velocity was northward at an average rate in excess of 20 cm/sec (17 km/ day) (Davidson Current). The August-September data suggested the presence of counter-clockwise gyres in Monterey Bay and the Gulf of the Farallones, but by the middle of October, the gyres were no longer evident. Imagery of April 1973 showed well developed plumes of suspended sediment in Monterey Bay from the Salinas River and in the Gulf of the Farallones from San Francisco Bay. ERTS-1 imagery provides an effective means of monitoring timber harvest in the redwood forest along the northern California coast. ERTS-1 imagery also clearly portrays contrasting topographic belts characterized by fluvial erosion and by mass movement. The most visually apparent and most persistent river mouth suspended sediment plumes are associated with those rivers that drain belts of topography that appear to have been eroded primarily by mass movement.

N74-14051*# Geological Survey, Denver, Colo.
A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA, AND AUSTRALIA Progress Report, 1 Nov. - 31 Dec. 1973
Edwin D. McKee, Principal Investigator and Carol S. Breed 1 Jan. 1974 12 p refs ERTS
(NASA Order S-70243-AG-4)
(E74-10187; NASA-CR-136326) Avail: NTIS HC $3.00 CSCL 08M

The author has identified the following significant results. Recent acquisition of generally high quality color prints for most of the test sites has enabled this project to make significant advances in preparing mosaics of sand desert areas under study. Computer enhancement of imagery, where details of complex dune forms need to be determined, has been achieved with arrival of computer-compatible ERTS-1 tapes. Further, a comparator, recently received, gives precise visual measurements of width, length, and spacing of sand bodies and so improves comparison of patterns in various test sites. Considerable additional meteorological data recently received on sand-moving winds in China, Pakistan, Libya, and other study areas enabled much progress to be made in developing overlays for the dune mosaics. These data show direction, speed, and frequency of winds. Other new data for use in preparing overlays used with ERTS-1 image mosaics include ground truth on moisture control, geologic settings, and plant distribution. With the addition of visual observation data and prints from hand-held photography now being obtained by the Skylab 4 mission, much progress in interpreting the patterns of sand seas for 17 desert sites is anticipated.

N74-14052*# Kansas Univ. Center for Research, Inc., Lawrence. Atmospheric Science Lab.
DETECTION OF MOISTURE AND MOISTURE RELATED PHENOMENA FROM SKYLAB Monthly Progress Report, Dec. 1973

Joe R. Eagleman, Ernest C. Pogge, Richard K. Moore, Principal Investigators, Norman Hardy, Wen Lin, and Larry League Dec. 1973 19 p EREP
(Contract NAS9-13273)
(E74-10188; NASA-CR-136327) Avail: NTIS HC $3.00 CSCL 08M

The author has identified the following significant results. Correlations between the S-194 antenna temperature and soil moisture have been obtained for three sets of data; one for Skylab 2 and two for Skylab 3. The best correlations were obtained for the surface to one inch depth in two cases and for the surface to two inches for the third case. Correlation coefficients for the surface to one inch depth were -0.98, -0.95, and -0.82. The lowest correlation coefficient was obtained with total soil moisture variations less than 4% across the test site.

N74-14053*# Stanford Univ., Calif. Remote Sensing Lab.
MULTISPECTRAL SIGNATURES IN RELATION TO GROUND CONTROL SIGNATURE USING NESTED SAMPLING APPROACH Progress Report, 4 Nov. 1973 - 3 Jan. 1974
R. J. P. Lyon and F. R. Honey, Principal Investigators 3 Jan. 1974 24 p ref ERTS
(Contract NAS5-21884)
(E74-10189; NASA-CR-136328) Avail: NTIS HC $3.25 CSCL 05B

The author has identified the following significant results. Principal effort has been on the development of a PDP-10 software package to read the CCT tapes more cheaply and rapidly. This is 90% completed and debugged. A shade print example of Treasure Island is provided. Stanford area was overflown with the U-2 as an add-on photographic mission to help fill in record-gaps in ERTS-1 overpass which was clouded out.

N74-14054*# Environmental Research Inst. of Michigan, Ann Arbor.
DETERMINATION OF THE EARTH'S AEROSOL ALBEDO USING SKYLAB DATA Quarterly Report, 1 Sep. - 1 Dec. 1973
Robert E. Turner, Principal Investigator 3 Jan. 1974 2 p EREP
(Contract NAS9-13279)
(E74-10190; NASA-CR-136329; ERIM-102200-7-L; QR-3) Avail: NTIS HC $3.00 CSCL 04A

There are no author-identified significant results in this report.

N74-14055*# National Ocean Survey, Rockville, Md. Photogrammetric Research Branch.
SKYLAB A PROPOSAL AEROTRIANGULATION WITH VERY SMALL SCALE PHOTOGRAPHY Quarterly Report, 15 Oct. 1973 - 15 Jan. 1974
Morton Keller, Principal Investigator 15 Jan. 1974 1 p EREP
(NASA Order T-4110-B)
(E74-10191; NASA-CR-136332) Avail: NTIS HC $3.00

There are no author-identified significant results in this report.

N74-14056*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDIES OF IMAGES OF SHORT-LIVED EVENTS USING ERTS DATA Progress Report, 1 Nov. - 31 Dec. 1973
William A. Deutschman, Principal Investigator 31 Dec. 1973 1 p ERTS
(Contract NAS5-21858)
(E74-10192; NASA-CR-136333) Avail: NTIS HC $3.00 CSCL 05B

The author has identified the following significant results. Detection of short-lived events has continued. Forest fires, oil spills, vegetation damage, volcanoes, storm ridges, earthquakes, and floods have been detected and analyzed.

N74-14057*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
NATURE AND CHANGES IN ORGANIC MATTER IN ORGANIC SEDIMENTS Annual Progress Report, Sep. 1972 - Aug. 1973
I. R. Kaplan Aug. 1973 34 p refs
(Grant NGR-05-007-221)
(NASA-CR-135901) Avail: NTIS HC $3.75 CSCL 08A

A series of isoprenoid compounds were isolated from a heat treated marine sediment (from Tanner Basin) which were not present in the original sediment. Among the compounds identified were: phytol, dihydrophytol, C-18-isoprenoid ketone, phytanic and pristanic acids, C-19- and C-10-monoolefines, and the alkanes pristane and phytane. The significance and possible routes leading to these compounds is discussed. Author

N74-14058*# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
INTERHEMISPHERIC COMPARISON OF ATMOSPHERIC CIRCULATION FEATURES AS EVALUATED FROM NIMBUS SATELLITE DATA Annual Report, 1 Jul. 1972-30 Jun. 1973
E. R. Reiter, T. H. VonderHaar, R. Adler, S. Srivatsangam, and Alice Fields 30 Jun. 1973 138 p refs Submitted for publication
(Grant NGR-06-002-098)
Avail: NTIS HC $9.00 CSCL 04A

A relationship is established between relative geostrophic vorticity on an isobaric surface and the Laplacian of the underlying layer-mean temperature. This relationship is used to investigate the distribution of vorticity and baroclinicity in a jet-stream model which is constantly recurrent in the winter troposphere. The investigation shows that the baroclinic and vorticity fields of the extratropical troposphere must be bifurcated with two extrema in the middle and subpolar latitudes. This pattern is present in daily tropospheric meridional cross-sections. The reasons for the disappearance of bifurcation in the time-and-longitude averaged distributions are discussed. Author

N74-14059# Scientific Translation Service, Santa Barbara, Calif.
BRIEF INFORMATION FROM THE STUDY GROUP OF THE MAJOR RESEARCH INSTITUTIONS ON "WORK IN THE AREA OF ENVIRONMENTAL RESEARCH AND ENVIRONMENTAL PROTECTION"
[1973] 60 p Transl. into ENGLISH of the West German report "Kurzinformation der AGF ueber Arbeiten auf dem Gebiet der Umweltforschung und des Umweltschutzes" Sponsored by EPA (TR-640-73) Avail: NTIS HC $5.00

The activities of European research facilities with respect to reduction of environment pollution are discussed. The areas investigated for the application of environmental improvements are: (1) disposal of plastics, sediments, and radioactive wastes, (2) environmental chemicals and biocides, (3) water quality, (4) oceans and coastal water problems, (5) air pollution, and (6) noise pollution. Tables are prepared to show the anticipated expenditure of effort during the period 1972 to 1975. Author

N74-14060# Technische Hochschule, Darmstadt (West Germany).
THE PLANETARY BOUNDARY LAYER OF THE ATMOSPHERE
F. Wippermann, D. Etling, H. Leykauf, and D. Yordanov 1973 354 p refs In ENGLISH; partly in GERMAN
Avail: NTIS HC $19.75

A collection of papers is presented which were published during the period from 1970 to 1973. Primary emphasis in the papers is placed on the possibility of parameterization of boundary layer effects, and therefore the whole planetary boundary layer is considered. For individual titles, see N74-14061 through N74-14067.

N74-14061 Technische Hochschule, Darmstadt (West Germany).
THE PLANETARY BOUNDARY LAYER: DEFINITIONS AND EQUATIONS
In its The Planetary Boundary Layer of the Atmosphere 1973 p 7-24 (For availability see N74-14060 05-13)

The equations governing the planetary boundary layer (PBL) are given. The equations are derived by starting with the basic equations and applying the conditions of the PBL. This is done not only for the mean quantities of the velocity components in both the x- and y-direction, the potential temperature, and the amount of water vapor but also for the different kinds of energy

such as the kinetic energy of the mean motion, the turbulent kinetic energy, the internal and potential energy, and the latent heat. In addition, a set of energy equations is derived showing the transformations between the different kinds of energy.
D.L.G.

N74-14062 Technische Hochschule, Darmstadt (West Germany).
SOME PROBLEMS IN MODELLING THE PLANETARY BOUNDARY LAYER
In its The Planetary Boundary Layer of the Atmosphere 1973 p 25-62 refs (For availability see N74-14060 05-13)

Problems occuring in the development of a theoretical PBL model are dealt with. Particular emphasis is placed on the problem of closing the PBL equations in general. Two types of models are reviewed; those based on a hypothesis for the eddy viscosity, and those based on a hypothesis for the mixing length. A method for solving the PBL equations is included. D.L.G.

N74-14063 Technische Hochschule, Darmstadt (West Germany).
THE STRUCTURE OF THE PLANETARY BOUNDARY LAYER
In its the Planetary Boundary Layer of the Atmosphere 1973 p 63-153 refs (For availability see N74-14060 05-13)

Several aspects of the structure of a PBL are dealt with including: (1) a relation between the eddy viscosity and the turbulent kinetic energy, (2) universal profiles in a barotropic or baroclinic PBL, (3) the energy budget of a PBL, (4) the wind profile very close to the ground, and (5) the low level jet.
D.L.G.

N74-14064 Technische Hochschule, Darmstadt (West Germany).
THE PARAMETERIZATION OF PBL EFFECTS WITH THE AID OF THE RESISTANCE LAW
In its The Planetary Boundary Layer of the Atmosphere 1973 p 154-219 refs (For availability see N74-14060 05-13)

The resistance law of the PBL combines small-scale PBL effects with the large-scale parameters of the boundary layer. Two different derivations of the resistance law are presented. Two universal constants appearing in the resistance law for a barotropic and neutral PBL are considered. The resistance law is also extended to baroclinic cases. The parameterization of the large-scale wind stress at the sea surface is analyzed. D.L.G.

N74-14065 Technische Hochschule, Darmstadt (West Germany).
NONSTATIONARY AND/OR HORIZONTALLY NONHOMOGENEOUS BOUNDARY LAYERS
In its The Planetary Boundary Layer of the Atmosphere 1973 p 220-254 refs (For availability see N74-14060 05-13)

It is demonstrated that if the resistance law is applied to determine turbulent fluxes in the real atmospheric boundary layer, an error will be made since the assumptions of a PBL are not satisfied in reality. This error is studied for the case of a clear day in summer time. A time-dependent boundary layer, model is utilized and the results are compared with those of the corresponding stationary cases. The effects of horizontal inhomogeneities of the surface roughness on the boundary layer are studied. Some models are developed which consider a sudden change in the temperature of the lower boundary. D.L.G.

N74-14066 Technische Hochschule, Darmstadt (West Germany).
THE DYNAMIC INSTABILITY OF THE ATMOSPHERIC BOUNDARY LAYER
In its The Planetary Boundary Layer of the Atmosphere 1973 p 255-298 refs In ENGLISH; partly in GERMAN (For availability see N74-14060 05-13)

The orientation of vortices is analyzed for the case in which the two superimposed vortex systems are orthogonal. A physical interpretation of these vortices is attempted and it is demonstrated that the vertical component of the Coriolis acceleration acts in the same manner as the centrifugal acceleration in a flow along a concave wall producing Taylor-Gortler vortices. The transistion to dynamic instability of atmospheric boundary layer (idealized as an Ekman layer) is investigated for different thermal stratifications.
D.L.G.

N74-14067 Technische Hochschule, Darmstadt (West Germany).
THE DISPERSION OF WINDBORNE MATERIAL IN THE PLANETARY BOUNDARY LAYER
In its The Planetary Boundary Layer of the Atmosphere 1973 p 299-332 refs In ENGLISH; partly in GERMAN (For availability see N74-14060 05-13)

The problem is considered of material dispersion with turbulent diffusion in the planetary boundary layer. The vertical profiles of the eddy diffusion coefficient and of the velocity defect are applied to the diffusion theory. The difference in the maximum concentration at the ground is analyzed when either a PBL model is applied or a time-dependent boundary layer model. In addition, the meteorological parameters are set forth which are considered relevant in a statistical analysis of air quality data.
D.L.G.

N74-14068*# Michigan State Univ., East Lansing. Kellogg Center for Continuing Education.
PROCEEDINGS OF THE CONFERENCE ON PRACTICAL APPLICATIONS OF REMOTE SENSING
May 1973 79 p refs Conf. held at East Lansing, Mich., 15-16 May 1973; sponsored by Mich. State Univ., NASA, and Environ. Res. Inst. of Mich.
(Grant NGL-23-004-083)
(NASA-CR-136316) Avail: NTIS HC $6.00 CSCL 08B

Conference papers dealing with the principles of remote sensing are summarized. Summaries cover problem solving capabilities within the realms of urbanism, agriculture, forestry, and environmental impact assessment. For individual titles, see N74-14069 through N74-14076.

N74-14069* Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
BASIC PRINCIPLES OF REMOTE SENSING
James L. Clapp *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 3-6 refs (For availability see N74-14068 05-13)
CSCL 08B

Forty-eight selected bibliographic references dealing with the remote sensing of the environment are given. Emphasis was placed on data that deal with fundamental aspects and principles of the technique. E.H.W.

N74-14070* Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
CHARACTERISTICS OF REMOTE SENSING SYSTEMS c14
Ralph W. Kiefer *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 7-8 (For availability see N74-14068 05-13)
CSCL 14E

The characteristics of photographic, thermal and multispectral scanners, radar, and ERTS satellite remote sensing systems are discussed. E.H.W.

N74-14071* Denver Univ., Colo.
REMOTE SENSING AND THE URBAN ENVIRONMENT: AN ASSESSMENT OF USEFULNESS
William B. Howard and Linda B. Driscoll *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 9-18 refs (For availability see N74-14068 05-13)
CSCL 08B

The usefulness of remote sensing in urban planning and development relative to social and economic factors as well as physical factors is examined. Particular attention was given to environmental quality assessment and land use problems.
E.H.W.

N74-14072* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE GREATER NEW ORLEANS STAR PROJECT
Joseph William Smollen, III *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 19-20 (For availability see N74-14068 05-13)

CSCL 08B

A description is given of STAR, a computer project designed to provide urban planners with needed information rapidly and accurately. Particular attention was given to planning for the New Orleans area. Attempts were also made to analyze interactive effects of urban problems and predict their effects on each other. E.H.W.

N74-14073* Geological Survey, Washington, D.C.
A LAND USE AND ENVIRONMENTAL IMPACT ANALYSIS OF THE NORFOLK-PORTSMOUTH SMSA
William B. Mitchel and G. Lennis Berlin (Northern Ariz. Univ., Flagstaff) *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 21-35 refs (For availability see N74-14068 05-13)
CSCL 08B

The feasibility of using remote sensing techniques for land use and environmental assessment in the Norfolk-Portsmouth area is discussed. Data cover the use of high altitude aircraft and satellite remote sensing data for: (1) identifying various heirarchial levels of land use, (2) monitoring land use changes for repetitive basis, (3) assessing the impact of competing land uses, and (4) identifying areas of potential environmental deterioration. High altitude aircraft photographs (scale 1:120,000) acquired in 1959, 1970, and 1972, plus Earth Resources Technology Satellite (ERTS-1) color composite images acquired in 1972 were used for the land use and environmental assessments. The high altitude aircraft photography, as expected, was successfully used to map Level 1, Level 2, as well as some urban Level 3 land use categories. However, the detail of land use analysis obtainable from the ERTS imagery exceeded the expectations for the U.S. Geological Survey's land use classification scheme. Study results are consistent with the initial investigation which determined Level 1 land use change to be 16.7 square km per year. Author

N74-14074* Daedalus Enterprises, Inc., Ann Arbor, Mich.
REVIEW OF OPERATIONAL APPLICATIONS OF INFRARED AND MULTISPECTRAL SCANNERS c14
Thomas R. Ory *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 36-39 (For availability see N74-14068 05-13)
CSCL 14B

A review was made of infrared and multispectral scanners. Operating principles, sensitivity, and costs are discussed. E.H.W.

N74-14075* California Univ., Berkeley. Forestry Remote Sensing Lab.
APPLICATION OF REMOTE SENSING IN FORESTRY
Donald T. Lauer *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 40-41 (For availability see N74-14068 05-13)
CSCL 02F

The use of remote sensing techniques in forestry studies is investigated. In particular, inventory, monitoring, detection, and management are discussed. Data show that infrared imagery appears to be the best technique for forestry studies. Data also show that color photographs are more easily interpreted than black and white ones. E.H.W.

N74-14076* California Univ., Berkeley. Forest Remote Sensing Lab.
APPLICATIONS OF REMOTE SENSING TO AGRICULTURE
Claire M. Hay *In* Mich. State Univ. Proc. of the Conf. of Pract. Appl. of Remote Sensing May 1973 p 42-43 (For availability see N74-14068 05-13)
CSCL 02C

Remote sensing applications to agriculture in the areas of: (1) general land use mapping and stratification, (2) identification, and inventory of distinct crops, and (3) detection of stress conditions and other factors affecting crop yields are discussed. Author

N74-14077# Finnish Meteorological Inst., Helsinki.
MAGNETIC RESULTS FROM NURMIJARVI GEOPHYSICAL OBSERVATORY, 1972
1973 33 p
Avail: NTIS HC $3.75

Data on terrestrial magnetism and magnetic disturbances were recorded at an observatory near Helsinki, Finland during 1972. The test equipment and methods for conducting the investigation are described. Data for each day are recorded in tabular form for the twenty-four hour period of each day. Author

N74-14078# Servico Meteorologico Nacional, Lisbon (Portugal).
A LOOK AT THE STRATOSPHERE
M. Nicolet 1972 13 p refs In FRENCH and ENGLISH Presented at Symp. on the Meteorol. Serv. Facing the Progr. in the Field of Meteorol. Present Situation and Prospects for the Decade 1971-1980, Lisbon, 4-8 Oct. 1971
Avail: NTIS HC $3.00

The distribution of the minor constituents of the stratosphere and their behavior are examined. Ozone-oxygen photodissociation, the effect of water vapor, and nitrogen oxide are discussed. F.O.S.

N74-14079# Danish Meteorological Inst., Charlottenlund.
GODHAVN GEOPHYSICAL OBSERVATORY, MAGNETIC RESULTS, 1967
1973 56 p refs
Avail: NTIS HC $5.00

Geomagnetic surveys were conducted by the Godhavn magnetic observatory in Denmark during 1967. Regular recording of the three magnetic elements were conducted by three sets of photographic variometers. Characteristics of the variometers are tabulated. Procedures for determining the baseline values and the reduction formulas used with the variometers are presented. Data for the hourly mean values of the geomagnetic parameters are tabulated. Author

N74-14080# Bureau of Meteorology, Canberra (Australia).
MONTHLY CLIMATE DATA - SURFACE, AUSTRALIA, MAY 1973
May 1973 73 p
Avail: NTIS HC $5.75

Climatological data recorded in Australia, Papua, New Guinea, and selected Pacific islands are presented. Meteorological parameters of atmospheric pressure, cloud cover, temperature, dewpoint, rainfall, and evaporation for each ground station are tabulated. Author

N74-14081*# Old Dominion Univ. Research Foundation, Norfolk, Va. Inst. of Oceanography.
EVALUATION OF SUBMARINE STRAIN-GAGE SYSTEMS FOR MONITORING COASTAL SEDIMENT MIGRATION
Gerald L. Shideler and Dennis G. Mcgrath Aug. 1973 59 p refs
(Contract NAS1-9434)
(NASA-CR-132366; TR-11) Avail: NTIS HC $5.00 CSCL 08C

Single and multiple strain-gage systems were respectively evaluated as in situ point and areal sensors for monitoring sand-height variations in coastal environments. Static loading tests indicate that gage response pressure is linear for sand heights up to 24 inches. Response pressures are a function of both sand height and aggregate density, with density being influenced by both sediment texture and degree of compaction. Poorer sediment sorting and greater compaction result in higher response pressures. Field tests in a beach foreshore environment indicate that the gage systems are effective qualitative instruments for monitoring long-period migration trends of beach sediments; whereas, short-period responses are not sufficiently reliable. The durability and compactness of the gage systems must be substantially increased for effective field operations. It is recommended that the systems' qualitative potentials be further developed, whereas their development as quantitative instruments be terminated. Further development should emphasize the construction of remote recording systems designed for semipermanent installation. Author

N74-14082*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REVISED TABLES OF AIRSPEED, ALTITUDE, AND MACH NUMBER PRESENTED IN THE INTERNATIONAL SYSTEM

OF UNITS
Margaret S. Benner and Richard H. Sawyer Washington 1973 42 p refs
(NASA-SP-3082) Avail: NTIS HC $3.00 CSCL 04A

Because inception of a national program to implement the International System of Units (SI) appears to be inevitable and imminent, the tables of airspeed, altitude, and Mach number prepared by Livingston and Gracey to serve for airspeed meter and altimeter calibrations and for the conversion of flight measurements of these quantities to related parameters - Mach number, true airspeed, equivalent airspeed, etc. - have been revised to the SI. Tables of airspeed in knots are also included because of the significance of this quantity in navigation. In addition, the data in the altitude tables have been revised to the U.S. Standard Atmosphere of 1962. The latter data reflect increased knowledge of the higher atmosphere and more precise determination of basic quantities, including the redefinition of the absolute thermodynamic temperature scale by the Tenth General Conference on Weights and Measures in 1954. The U.S. Standard Atmosphere, 1962, corresponds to the International Civil Aviation Organization (ICAO) Standard Atmosphere up to 20 kilometers (geopotential altitude). A table of conversion factors for various pressure units is presented in SI Units. Author

N74-14083# Scientific Translation Service, Santa Barbara, Calif.
THE SPECTRAL TRANSPARENCY OF THE ANTARCTIC ATMOSPHERE. PART 2: RESULTS AND ANALYSIS
Michael Kuhn [1973] 61 p refs Transl. into ENGLISH from Arch. Metrol., Geophys. Bioklimatol., Ser. B (Vienna), V. 2g 1972 p 299-344 Sponsored by EPA
(TR-512-73-Pt-2) Avail: NTIS HC $5.25

Aerosol extinction coefficients were determined from the intensities of direct solar radiation recorded by pyrheliometers in five spectral bands at Plateau Station in the heart of the East Antarctic Plateau (79 deg 15' S, 40 deg 30' E, 3625 m). The radiation climate of the region is discussed with respect to general circulation. A number of turbidity parameters is computed from the measurements. The particle size spectrum is inferred from spectral extinction coefficients: there is a well-defined background that was disturbed, in one summer, by volcanic particles from the Agung eruption. Occasional disturbances in the red part of the spectrum are attributed to condensation products. Ozone absorption in the Chappuis bands is computed by successive approximation. Precipitable water vapor is determined from pyrheliometer measurements with three different methods. Daily and seasonal variations of turbidity are discussed as well as the reaction of atmospheric transparency to changes in weather.
Author

N74-14084# Advisory Group for Aerospace Research and Development, Paris (France).
NUMERICAL MODELS OF TOTAL ELECTRON CONTENT OVER EUROPE AND THE MEDITERRANEAN AND MULTI-STATION SCINTILLATION COMPARISONS
John A. Klobuchar (AFCRL) and Jules Aarons (AFCRL) Nov. 1973 50 p refs
(AGARD-AG-166A; AGARDograph-166A) Avail: NTIS HC $4.50

A numerical model of the total electron content over Europe for sunspot minimum conditions was described, and a complete computer subroutine of the model is given. A TEC model value was obtained from the subroutine by specifying a season for one of the solar flux conditions contained in the model, a geographic latitude, and a local time. Computer drawn isocontours of the original TEC data are shown, along with contours of the model output. For individual titles, see N74-14085 through N74-14088.

N74-14085 Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Ionospheric Physics Lab.
A NUMERICAL MODEL OF TEC OVER EUROPE FOR SUNSPOT MINIMUM CONDITIONS - 2
John A. Klobuchar *In* AGARD Numerical Models of Total Electron Content over Europe and the Mediterranean and Multi-Station Scintillation Comparisons Nov. 1973 p 2-15 refs (For availability see N74-14084 05-13)

The complete model computer program is given, along with the coefficients necessary to determine TEC at any local time and latitude for each of nine different seasons. Also shown are computer drawn isocontours, redrawn from the original data, and isocontours of the model output for each season. Author

N74-14086 Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Ionospheric Physics Lab.
A NUMERICAL MODEL OF TEC OVER THE MEDITERRANEAN AREA
John A. Klobuchar *In* AGARD Numerical Models of Total Electron Content over Europe and the Mediterranean and Multi-Station Scintillation Comparisons Nov. 1973 p 16-22 (For availability see N74-14084 05-13)

A numerical computer program subroutine model of the total electron content (TEC) of the ionosphere over the Mediterranean area was constructed using mean seasonal data taken at Athens, Greece. Data for four seasons are available and a separate numerical model representation of the data was made for each season. The TEC of the ionosphere produces an additional delay in the travel time of radio waves over their free space velocity. Thus, a numerical representation of this additional time delay can be useful in planning and operating such systems. Author

N74-14087 Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Ionospheric Physics Lab.
MULTI-STATION OBSERVATIONS: NOVEMBER 1971 - MARCH 1972
Jules Aarons *In* AGARD Numerical Models of Total Electron Content over Europe and the Mediterranean and Multi-Station Scintillation Comparisons Nov. 1973 p 24-29 refs (For availability see N74-14084 05-13)

In November 1971, observations of the 136 MHz beacon of Intelsat 2F2 became possible in Western Europe. With the advent of multistation observations in Western Europe, a comparison of middle to low latitude data became feasible.
Author

N74-14088 Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Ionospheric Physics Lab.
THE EFFECT OF THE AUGUST 1972 MAGNETIC STORMS ON SCINTILLATION
Jules Aarons and Eileen Martin (Emmanuel Coll.) *In* AGARD Numerical Models of Total Electron Content over Europe and the Mediterranean and Multi-Station Scintillation Comparisons Nov. 1973 p 30-44 ref (For availability see N74-14084 05-13)

During the period 2 August to 10 August 1972, a series of flares on the sun triggered another series of geophysical events. The resulting magnetic storms were of great intensity with K sub p reaching values of 9, the maximum index, twice. The effect on scintillations is of interest in two ways. First, it provides a worst case period so that a long time interval can be analyzed. Secondly, it provides a test for the descriptive model.
Author

N74-14089*# Linguistic Systems, Inc., Cambridge, Mass.
THE EARTH'S HYDROMAGNETIC DYNAMO
S. I. Braginsky Washington NASA Jan. 1974 29 p refs Transl. into ENGLISH from Priroda (Moscow), no. 9, Sep. 1973 p 32-41
(Contract NASw-2482)
(NASA-TT-F-15211) Avail: NTIS HC $3.50 CSCL 08N

It is now known that the earth is itself a magnet, and so the source of its own magnetic field. The origin and various characteristics of the geomagnetic field that were discovered as a by-product of paleomagnetology are discussed. Different theories accounting for it (the hydromagnetic dynamo theory) are presented along with the epochal variations of the geomagnetic field.
Author

N74-14090*# Purdue Univ., Lafayette, Ind.
THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO THE SOLUTION OF PROBLEMS IN THE MANAGEMENT OF RESOURCES IN INDIANA Semiannual Status Report, 1 Jun. - 30 Nov. 1973
D. A. Landgrebe 30 Nov. 1973 22 p ref
(Grant NGL-15-005-186)
(NASA-CR-136470) Avail: NTIS HC $3.25 CSCL 08F

In an effort to bridge the gap between the research community

and the user agencies, this investigation was designed to take the remote sensing technology and products of that technology to the user agencies and to assist them in the use of this technology. The first semi-annual report summarizes the progress which has been made in the following specific projects: (1) pilot study for land use inventory of the Great Lakes Watershed; (2) resource inventory of Marion County (Indianapolis), Indiana; (3) resource inventory of 8 central Indiana counties for the Indiana Heartland Coordinating Commission; (4) applications within the Indiana Department of Natural Resources; (5) applications within the Indiana Department of Commerce; and (6) applications within the USDA Soil Conservation Service. Author

N74-14091# Environmental Data Service, Washington, D.C. Center for Experiment Design and Data Analysis.
BOMEX RAINY DAY ANALYSIS
Garry W. Elliott Jul. 1973 13 p refs
(NOAA-TM-EDS-BOMAP-10) Avail: NTIS HC $3.00

An investigation was made during the Barbados Oceanographic and Meteorological Experiment (BOMEX) in 1969 to evaluate the possibility of determining total precipitation from the change in salinity or temperature at the ocean surface. Salinity-temperature-depth (STD) soundings were taken at 3-hr intervals during periods of no rain, and at 5- to 6-min intervals during periods of rain. Analysis of salinity data shows that during periods of no rain, salinity regularly fluctuated by + or - 0.15 deg/oo. Fluctuations of this magnitude are likely to obscure possible salinity depressions due to rainfall. No rainfall-related long-term salinity depressions were evident. Many sharp, short-term depressions of salinity, on the order of 10 to 45 min, however, were observed during periods of rainfall. Author

N74-14092# RAND Corp., Santa Monica, Calif.
ANTARCTIC ICEBERGS AS A GLOBAL FRESH WATER RESOURCE
J. L. Hult and N. C. Ostrander Oct. 1973 91 p refs
(Grant NSF GI-34981)
(R-1255-NSF) Avail: NTIS HC $6.75

Background information is presented for potential users and suppliers of Antarctic icebergs, and for governments or agencies concerned with the development, regulation, or control of the use of these ice resources. Major areas of discussion include: potential fresh water demands and resources; technological feasibility of moving and converting icebergs for fresh water and heat sink; and assessment of societal and environmental impacts. Appendices on the cost of moving icebergs and iceberg transport models are included. K.M.M.

N74-14093*# Kansas Univ. Center for Research, Inc., Lawrence.
RESEARCH ON THE APPLICATION OF SATELLITE REMOTE SENSING TO LOCAL, STATE, REGIONAL, AND NATIONAL PROGRAMS INVOLVED WITH RESOURCE MANAGEMENT AND ENVIRONMENTAL QUALITY Semiannual Progress Report, Apr. - Sep. 1973
Robert L. Walters, Robert J. Eastmond, and B. G. Barr Sep. 1973 69 p refs
(Grant NGL-17-004-024)
(NASA-CR-136472) Avail: NTIS HC $5.50 CSCL 08F

Project summaries and project reports are presented in the area of satellite remote sensing as applied to local, regional, and national environmental programs. Projects reports include: (1) Douglas County applications program; (2) vegetation damage and heavy metal concentration in new lead belt; (3) evaluating reclamation of strip-mined land; (4) remote sensing applied to land use planning at Clinton Reservoir; and (5) detailed land use mapping in Kansas City, Kansas. K.M.M.

N74-14094# Citizens' Advisory Committee on Environmental Quality, Washington, D.C.
REPORT TO THE PRESIDENT AND TO THE COUNCIL ON ENVIRONMENTAL QUALITY
Oct. 1973 48 p refs
Avail: SOD HC $1.05

A report on the effectiveness of environmental protection methods is presented. The report was prepared for the President by the Citizens' Advisory Committee on Environmental Quality. The subjects discussed include: (1) actions taken to improve waste disposal, (2) land use action legislation, (3) environmental impact statements, (4) protection of agricultural lands, (5) center city improvement efforts, (6) urban transportation systems, (7) preservation of historic features, and (8) energy conservation measures. Author

N74-14095# Melbourne Univ., Parkville (Australia). Dept. of Physics.
STRATOSPHERIC WINDS OVER AUSTRALIA, 20 DEG SOUTH TO 40 DEG SOUTH, 1966 - 1972 Final Report
J. E. Laby and E. L. Unthank Nov. 1972 94 p refs
(Contract AT(30-1)-3747)
(NYO-3747-20) Avail: NTIS HC $6.75

Results and analyses reported herein are based on data collected to the end of 1971 under contract of the U.S.A.E.C., Biology and Fallout Division. This report updates an earlier analysis (1970), which gave details of results prior to January 1970. The data analyzed were obtained from radar-tracked neoprene balloon fights in which the balloon loads were limited to a radar target only, in order to achieve maximum height from relatively small balloons (1200 gm or less nominal weight). Several methods, including the valve technique of Hopper and Laby (1960) and the use of bleeder tubes, were used to further improve height performance of these balloons. NSA

N74-14096# International Centre for Theoretical Physics, Trieste (Italy).
PARTICLES PHYSICISTS APPROACH TO THE THEORY OF GRAVITATION
M. J. Duff Jul. 1973 53 p refs
(IC-73/70) Avail: AEC Depository Libraries HC $4.75

The lectures cover gravity without geometry, quantum theory and the Schwarzschild solution, linearity versus nonlinearity for the significance of perihelion shift calculations, and quantizing the gravitational field. NSA

N74-14097# Sydney Univ. (Australia). Dept. of Mechanical Engineering.
ALTERNATIVE ENERGY SOURCES: A RESEARCH CHALLENGE
D. W. George 1973 21 p refs Presented at Symp. on the Energy Crisis: Implications for Secondary Ind., Sydney, 23 May 1973
(Conf-730560-1) Avail: AEC Depository Libraries HC $3.25

Methods of obtaining energy such as controlled thermonuclear fusion, direct solar conversion, or deep geothermal resources of energy are considered alternative energy sources in a global sense. In Australia, nuclear fission and natural gas are considered alternative or unconventional energy sources. One significant area of alternative energy source discussed is the energy currently dissipated to the environment in a nonproductive manner through the limitations of conventional conversion technology and which in overall terms often exceeds that actually used by a factor of two or three. Research into improved methods of conversion includes areas such as MHD power generation and fuel cells. It also includes the concept of total industrial energy. Other alternative energy sources discussed include the natural sources of primary energy, namely, solar energy, tidal energy, wind, and geothermal energy. NSA

N74-14098# Environmental Prediction Research Facility (Navy), Monterey, Calif.
STATE OF THE SEA AROUND TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC OCEAN
Samson Brand, Jack W. Blelloch, and Donald C. Schertz Jun. 1973 28 p refs
(AD-767030; ENVPREDRSCHFAC-tech-paper-5-73) Avail: NTIS CSCL 08/3

The combined sea-height data for the year 1971 for the western North Pacific Ocean are examined to determine the sea-state characteristics around tropical storms and typhoons. The results from subjectively analyzed sea-state charts show that the areal extent about the storms of the combined sea height in the 9-15 ft range is primarily a function of storm duration, intensity (maximum sustained wind) and size. Equations derived by linear regression techniques are presented for describing the state of the sea about tropical cyclones. Author (GRA)

N74-14099# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MILLSTONE HILL THOMSON SCATTER RESULTS FOR 1968
John V. Evans 23 Jan. 1973 89 p refs
(Contract F19628-73-C-0002; DA Proj. 7X2-63304-D-215)
(AD-767251; TR-499; ESD-TR-73-55) Avail: NTIS CSCL 04/1

The report summarizes the results for the electron density distribution, electron and ion temperatures in the F-region obtained during 1968 using the Millstone Hill Thomson (incoherent) scatter radar system. These data, for the height interval approximately 200 to 800 km, were gathered over 24-hour observing periods, roughly twice per calendar month. The time required to obtain a complete electron density and temperature profile over this height interval was usually 30 minutes. During 1968 the apparatus employed to measure the frequency spectrum of the reflected signals vs altitude, which in turn yields the estimates of the electron and ion temperatures, was rebuilt permitting the measurements at all altitudes to be made in real time, and with greater accuracy than heretofore. In addition, the new spectrum analyzer permitted the first measurements at millstone Hill of the vertical drift of the plasma. The density and temperature results show that the separate clear patterns of summer and winter diurnal behavior, recognized at sunspot minimum, can still be discerned at sunspot maximum on all but very disturbed days. (Modified author abstract) GRA

N74-14100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVARIANT-GROUP METHOD IN BOUNDARY VALUE PROBLEMS OF THE PLANETARY DYNAMICS OF THE ATMOSPHERE
V. A. Efimov 18 Sep. 1973 16 p refs Transl. into ENGLISH from Gidrodinamicheskie Issled Tsirkulvatsii Atm. (USSR), no. 256, 1970 p 147-154
(AD-768045; FTD-HT-23-506-73) Avail: NTIS CSCL 04/2

The group properties of differential equations are examined with respect to solutions determined in a region with given boundary conditions. Starting with a system of equations of the lie group, invariants of the extended group, and the differential invariant manifolds are derived. It is concluded that a solution to equations of atmospheric dynamic in a series of generalized spherical functions leads to the separation of variables in all terms of the equation. This makes it possible to solve problems of nonlinear atmospheric dynamics in the coriolis field. F.O.S.

N74-14101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASSIGNING HEAT FLOWS DURING NUMERICAL EXPERIMENTS USING A THERMOTROPIC MODEL
R. L. Kagan and K. Ya. Innikov 18 Sep. 1973 17 p refs Transl. into ENGLISH from Gidrodinamicheskie Issled. Tsirkulyatsii Atm. (USSR), no. 256 p 98-107
(AD-767987; FTD-HT-23-504-73) Avail: NTIS CSCL 04/2

The article contains a description of climatological data on the total heat flow to the atmosphere, used for performing numerical experiments on the long-term integration of equations of the thermotropic model of atmospheric circulation. Analysis of these data is necessary for an understanding of the results of numerical experiments with this model, and is also of independent interest. GRA

N74-14102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARGED PARTICLES IN THE EARTH'S LOWER ATMOSPHERE
E. G. Shvidkovskii, Yu. A. Bragin, and O. K. Kostko 6 Sep. 1973 26 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 100, 1970 p 22-35
(AD-767988; FTD-HT-23-663-73) Avail: NTIS CSCL 04/1

The results of experimental and theoretical studies of the ion structure of the lower atmosphere are generalized and several deliberations concerning the direction of further work in this area are expressed. GRA

N74-14103# Institute for Telecommunication Sciences, Boulder, Colo.
SOURCE-TO-OBSERVER DISTANCE DEPENDENCE OF THE SURFACE IMPEDANCE AND WAVE TILT FOR A LINE-SOURCE EXCITED TWO LAYER EARTH
James R. Wait (Cooperative Inst. for Res. in Environ. Sci., Boulder, Colo.) and Kenneth P. Spies 4 Sep. 1973 52 p refs
(Contract NAonr-15-71; NR Proj. 081-270)
(AD-767089; TR-6) Avail: NTIS CSCL 08/7

The integral representations for the field components are evaluated numerically and compared with often used asymptotic formulas. It is found that the latter have a limited range of validity when the substratum is highly resistive. In general, the distance to the source cable must be allowed for in the interpretation of the observed fields. Numerical results for the relevant parameters are included. Author (GRA)

N74-14104# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOLECULAR OXYGEN IN A SINGLET DELTA (G) STATE IN THE UPPER ATMOSPHERE
M. N. Vlasov 17 Sep. 1973 37 p refs Transl. into ENGLISH from Tr. Inst. Prikl. Geofiz. (Leningrad), no. 16, 1971 p 21-42
(AD-768051; FTD-HT-23-799-73) Avail: NTIS CSCL 07/4

The translation discusses molecular oxygen in the upper atmosphere, especially the a singlet Delta(g) excited electronic state. The report includes a review of some experimental observations, theories of formation, and relevant kinetics and photochemistry. GRA

N74-14105# Tennessee Univ., Knoxville. Water Resources Research Center.
STRIP-MINED WATERSHED HYDROLOGIC DATA ACQUISITION STUDY
Bruce A. Tschantz 27 Aug. 1973 24 p refs
(Contract DI-14-31-0001-3843)
(PB-223558/8GA; OWRR-A-030-TENN(1); W73-14368; RR-35) Avail: NTIS HC $2.75 CSCL 08H

Remotely sensed aerial photography of two small strip mined East Tennessee watersheds was used as a means for obtaining land use information essential to econometric and hydrologic studies and for reclamation practice surveillance. 1:12,000 scale maps were produced for both watersheds from three color IR photographic flights. Other available high altitude photography and thermal imagery data were used to help map strip mine disturbed areas. The study demonstrated the usefulness of using low altitude IR photography for identifying, mapping, and measuring strip mine disturbance areas. (Modified author abstract) GRA

N74-14106# Washington Univ., Seattle. Div. of Marine Resources.
ARCTIC ICE DYNAMICS JOINT EXPERIMENT, AIDJEX BULLETIN
Jul. 1973 208 p refs
(Grant NSF C-625)
(PB-223387/2GA; AIDJEX-Bull-21; AIDJEX-73-21) Avail: NTIS HC $5.50 CSCL 04B

Two-dimensional stress and strain-rate in a floating ice cover, the thickness distribution of sea ice, steady drift of an incompressible Arctic ice cover, mesoscale strain in sea ice, and a method for calculating boundary stress in an atmospheric boundary layer are examined. Futher work in remote-sensed data analysis is also discussed, in particular sonar mapping of the underside of sea ice and determining pressure ridge frequency distributions from laser data. GRA

N74-14107# Cornell Univ., Ithaca, N.Y. School of Civil and Environmental Engineering.
HEAT AND WATER VAPOR EXCHANGE BETWEEN WATER SURFACE AND ATMOSPHERE
Wilfried Brutsaert May 1973 60 p refs Sponsored by EPA
(PB-222939/1; EPA-R2-73-259; W73-13663) Avail: NTIS MF $1.45; SOD HC $0.90 Domestic Postpaid or $0.65 GPO Bookstore CSCL 04B

The physical and mathematical aspects of simultaneous turbulent heat and water vapor exchange between a large open water body and the surrounding atmosphere is studied. Analytical and numerical solutions are developed for various conditions of fetch, surface roughness, atmospheric stability, etc., that are likely to be of physical importance. One of the main findings is that

in spite of some theoretical limitations the semi-empirical turbulent diffusion model provides a method for the prediction of heat and water vapor transfer, that should be useful for engineering calculations. GRA

N74-14108# National Oceanic and Atmospheric Administration, Silver Spring, Md. Environmental Data Service.
INTERNATIONAL DECADE OF OCEAN EXPLORATION, JANUARY 1970 TO JULY 1972 Progress Report
Jan. 1973 39 p refs
(PB-223331; NSF/IDOE-73-19) Avail: NTIS HC $4.00 CSCL 08J

The report provides the scientific community and other interested persons with information, data inventories, and lists of scientific reports pertinent to ocean exploration. The text is arranged according to the program areas established for IDOE. The appendix contains the National Marine Data Inventory (NAMDI), a computerized summary of reported observations made at sea during the period. The program areas are: Environmental quality environmental forecasting seabed assessment program, and living resources. GRA

N74-14109# Geological Survey, Denver, Colo.
A FORTRAN 4 COMPUTER PROGRAM FOR DETERMINATION OF AIRBORNE CAMERA AND SCANNER VARIABLES IN GEOLOGIC REMOTE SENSING Final Report
Stephen S. Hart 1973 16 p refs
(PB-222862/5; USGS-GD-73-030) Avail: NTIS HC $3.00 CSCL 08G

A FORTRAN 4 computer program for determination and comparison of optimum variables for conventional and multiband cameras, and thermal infrared and multispectral scanners, was utilized in geologic remote sensing research. The variables determined include flightline separation, photo scale, resolution, intervalometer setting, image motion compensation, and amount of film per flightline mile for cameras. GRA

N74-14110# Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research.
LINEAR SYSTEMS TECHNIQUES APPLIED TO HYDROLOGIC DATA ANALYSIS AND INSTRUMENT EVALUATION. A CASE STUDY ON DATA FROM THE ALICE SPRINGS AREA
P. S. Eagleson and M. J. Goodspeed 1973 63 p refs
(PB-223330/2; TP-34) Avail: NTIS HC $5.25 CSCL 08H

Methods of linear systems analysis are applied to questions of instrumentation adequacy and rainfall-run-off relations for a network of experimental catchments in the Alice Springs area. The methods used are expounded in some detail. The study is preliminary in that sufficient data are not yet available for more than tentative conclusions to be drawn regarding rainfull-run-off relations. However, it is concluded that the instrumentation is adequate in performance for the purposes intended. Applicability of the techniques to other situations is discussed. Author (GRA)

N74-14274 California Univ., Berkeley. Dept. of Chemistry.
REACTION OF OZONE WITH NITROGEN OXIDES AT HIGH ALTITUDES
Harold S. Johnston and Gary Whitten *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs Sponsored by DOT (For availability see N74-14271 05-20)

N74-14275 Meteorological Office (Gt. Brit.).
NITROGEN OXIDES, NUCLEAR WEAPON TESTING, CONCORDE AND STRATOSPHERIC OZONE
P. Goldsmith, A. F. Tuck, J. S. Foot, E. L. Simmons, and R. L. Newson *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 15 p refs (For availability see N74-14271 05-20)

N74-14278 Oslo Univ. (Norway). Inst. of Geophysics.
EFFECT OF SUPERSONIC TRANSPORT UPON THE OZONE LAYER, STUDIED IN A TWO-DIMENSIONAL PHOTOCHEMICAL MODEL WITH TRANSPORT
Eigil Hesstvedt *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 8 p refs (For availability see N74-14271 05-20)

N74-14279 Institut d'Aeronomie Spatiale de Belgique, Brussels.
CHEMICAL KINETIC IN THE STRATOSPHERE
G. Brasseur *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

N74-14283 Chemical Defence Experimental Establishment, Porton (England).
GROUND CONTAMINATION BY FUEL JETTISONED FROM AIRCRAFT
N. L. Cross and R. G. Picknett IN AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 9 p refs (For availability see N74-14271 05-20)

N74-14306 Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Toxicology Branch.
ENVIRONMENTAL TOXICOLOGICAL IMPACT OF AIRCRAFT OPERATIONS
Kenneth C. Back *In* AGARD Atmospheric Pollutation by Aircraft Engines Sep. 1973 6 p refs (For availability see N74-14271 05-20)

N74-14519* Arizona Univ., Tucson.
WATER-VAPOR MEASURES, MT. LEMMON AREA
Gerard P. Kuiper and L. Randic *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 60-69 (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 04A

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N74-14111 British Broadcasting Corp., Kingswood (England). Research Dept.
SOLID STATE SENSORS: THE USE OF A SINGLE DIMENSION 512 ELEMENT ARRAY FOR FILM SCANNING
D. T. Wright Nov. 1973 21 p refs
(BBC-RD-1973/32) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Following some early experiments with a 72 element self-scanned linear array of photo-diodes, a 512 element array was obtained. This was used to scan continuously moving film since this provides a convenient means of assessing the potential of single dimension solid state image pick up devices. The method of application and the resulting performance are discussed.
Author

N74-14112# Carleton Univ., Ottawa (Ontario). Dept. of Electronics and Materials Engineering.
PICOSECOND FRAMING PHOTOGRAPHY OF SECOND HARMONIC PULSES AND LASER PRODUCED PLASMAS USING AN OPTICAL KERR EFFECT SHUTTER
Kenneth Sala Oct. 1973 239 p refs Sponsored by Natl. Res. Council
Avail. NTIS HC $14.00

The development and application of a framing camera having a time resolution of approximately 5 psec is reported. The camera employs a transverse gating, focal plane, optical Kerr effect shutter in conjunction with an image converter streak camera. Framed photographs of the individual second harmonic picosecond pulses derived from a passively mode locked Nd:glass laser are presented, along with measurements of picosecond pulse width variation with position in the laser pulse train. In addition, picosecond-exposure framed photographs of laser produced plasmas in air and on solid targets are presented and spatial and temporal development of the laser produced spark is described. The dynamic spatial resolution of the optical Kerr effect shutter is measured and found to be much greater than 16 line pairs/mm, and method

of measuring both the optical Kerr coefficients and orientation relaxation times of liquids is proposed. Author

N74-14113*# ITT Aerospace/Optical Div., Fort Wayne, Ind.
HIGH RESOLUTION INFRARED RADIATION SOUNDER FOR THE NIMBUS F SPACECRAFT Quarterly Report, Jul. - Sep. 1973
E. W. Koenig et al Oct. 1973 42 p
(Contract NAS5-21651)
(NASA-CR-132885) Avail: NTIS HC $4.25 CSCL 14B

The activities on the HIRS program are described for the period of July through September, 1973. Completion of design activity and early fabrication effort on the protoflight unit were the major efforts. Operation of the engineering model in spacecraft integration tests was completed during July and August, after which the unit was returned for added test and evaluation. Author

N74-14114# Joint Publications Research Service, Arlington, Va.
MAGNETIC MICROVARIATIONAL MEASUREMENTS AND APPARATUS FOR MAGNETOTELLURIC RESEARCH
N. F. Krotevich 13 Dec. 1973 22 p Transl. into ENGLISH from the book "Magnitnyye Mikrovariatsionnyye Izmereniya i Apparatura dlya Magnitotellunicheskikh Issledovaniy" Novosibirsk, Nauka, 1972 24 p
(JPRS-60767) Avail: NTIS HC $3.25

Data are presented on the design and testing of microvariational instruments. Discussions concerning sources of internal noise are included along with the design of magnetostatic pickups and their use in geophysical surveys. Author

N74-14115*# Santa Clara Univ., Calif.
SYSTEM FOR MEASURING DRAG FORCES IN A TURBULENTLY FLOWING FLUID Patent Application
Dah Yu Cheng, inventor (to NASA) Filed 12 Dec. 1973 19 p Sponsored by NASA
(NASA-Case-ARC-10755-1; US-Patent-Appl-SN-424013) Avail: NTIS HC $3.00 CSCL 14B

A system for measuring the drag forces in a turbulently flowing fluid is described. The system consists of a sensing apparatus for dynamically sensing the mainstream and the cross velocity components of the fluid, a transducer to provide two alternating current electrical output signals representative of the velocity components, and signal processors to process and shape the electrical signals. A numerical analysis of the performance of the sensors is provided. NASA

N74-14116# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD FLIGHT TEST INSTRUMENTATION SERIES. VOLUME 4: THE MEASUREMENT OF ENGINE ROTATION SPEED
M. Vedrunes, W. D. Mace, ed., and A. Pool, ed. Oct. 1973 32 p refs 4 Vol.
(AGARD-AG-160-Vol-4) Avail: NTIS HC $3.75

The techniques and systems used to measure engine rotation speeds are analyzed. Chronotachometers, tachogenerators, and magnetic sensors are discussed along with the design of airborne measuring systems. The advantages and disadvantages of each type are presented. The telemetry systems and calibrations procedures are described. For Vol. 2 see N73-2049, for Vol. 3 see N72-25420. F.O.S.

N74-14117# Oak Ridge National Lab., Tenn.
APPARATUS FOR TESTING THE CREEP STRENGTH OF METALS IN LIQUID MEDIA
M. G. Khitarishvili, I. I. Vasilenko, N. N. Zhagalyak, R. K. Melekhov, and M. I. Filevich [1973] 5 p refs Transl. into ENGLISH from Fiz.-Khim. Mekh. Mater. (USSR), v. 8, no. 5, 1972 p 88-90 Sponsored by AEC
(ORNL-tr-2706) Avail: NTIS HC $3.00

Apparatus with shear strengths of 40 and 30 tons for testing corrosion cracking of steel samples 18 to 25 mm in diameter was constructed. Other apparatus for simulation of heat-power equipment operating conditions and for determining the tendency of metals toward corrosion cracking by use of a cantilever arm is described. NSA

N74-14118# Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science.
EXPERIMENTAL IN HIGH-VOLTAGE ELECTRON MICROSCOPY Progress Report
T. E. Mitchell, G. Das, E. A. Kenik, and P. S. Sklad 1 Aug. 1973 23 p refs
(Contract AT(11-1)-2119)
(COO-2119-5) Avail: NTIS HC $3.25

Dislocations provide a biased sink for interstitials, and thus voids cannot be produced in thin areas of annealed foils because the foil surface is an effective sink for both point defects and dislocations produced by loop formation. However, voids can be produced if the flux is increased, if soils are deformed and contain a high dislocation density, or if thicker areas are irradiated. Results are reported on: (1) radiation-induced are radiation-enhanced precipitation in an Al-4% Cu alloy and in a 304 stainless steel (M23C6 precipitates), (2) preliminary observations on the precipitate structures of some commercial cobalt alloys (WI52) in the as-cast and heat-treated form, (3) defect clusters produced by radiation damage in vanadium, (4) displacement damage and ionization damage in synthetic quartz, resulting in a transformation to the amorphous state, and (5) black spots defects produced by irradiation of sapphire (Al2O3). Author (NSA)

N74-14119# Sandia Labs., Albuquerque, N.Mex. Signal Analysis Div.
AIRCRAFT VELOCITY MEASUREMENT THROUGH RADAR-ALTIMETER ECHO: A THEORETICAL INVESTIGATION
Charles S. Williams Jul. 1973 36 p refs Sponsored by AEC
(SLA-73-669) Avail: NTIS HC $4.00

An examination of the character of the fading of the echo of a radar altimeter indicates that it might be used to obtain aircraft velocity with considerable accuracy. This preliminary examination considers neither the hardware problems nor the problems that an extremely rough terrain might cause. Author (NSA)

N74-14120# Rutherford High Energy Lab., Chilton (England). Computer and Automation Div.
PROCEEDINGS OF A SEMINAR ON TRACK ANALYSIS FOR RAPID CYCLING BUBBLE CHAMBERS
R. A. Lawes, ed. and C. M. Fisher, ed. Mar. 1973 200 p refs Conf. held at Chilton, Engl., 14 Feb. 1973
(RHEL/R-271; Conf-730215) Avail: NTIS HMSO £2.50; PHI $9.85

Data obtained from measuring instruments, such as vidicons used to obtain positional information from spark or bubble chambers, are prone by systematic errors. These errors can be removed by using measurements from a fiducial system to obtain a correcting polynomial giving true position as a function of measured position. To overcome the time consuming evaluation of this function a special-purpose digital machine capable of evaluating polynomial functions at high speed can be used. When placed between the digitized detector, output and the computer input it provides a perfect detector or alternatively it can be viewed as a special-purpose computer peripheral performing fast subroutine. The system is described. Future developments will include a hardware floating point capability, more flexible command and microprogramming to allow calculations to be chained in the machine rather than referring (with a time penalty) back to the host computer, and the use of read only memories for widely used general purpose functions. NSA

N74-14121*# Brookhaven National Lab., Upton, N.Y.
RECENT PROGRESS IN THE TRANSITION RADIATION DETECTOR TECHNIQUES
L. C. L. Yuan 1973 15 p refs Presented at Intern. Conf. on Instrumentation for High Energy Phys., Frascati, Italy, 8 May 1973 Sponsored by AEC and NASA
(NASA-CR-136528; BNL-18038; Conf-730531-7) Avail: NTIS HC $3.00

A list of some of the major experimental achievements involving charged particles in the relativistic region are presented. With the emphasis mainly directed to the X-ray region, certain modes of application of the transition radiation for the identification and separation of relativistic charged particles are discussed. Some recent developments in detection techniques and improvements in detector performances are presented. Experiments were also

carried out to detect the dynamic radiation, but no evidence of such an effect was observed. Author (NSA)

N74-14122# California Univ., Livermore. Lawrence Livermore Lab.
PICOSECOND IMAGE-CONVERTER STREAK CAMERAS FOR LASER DIAGNOSTICS
L. W. Coleman 13 Aug. 1973 11 p refs Presented at Meeting of the Soc. of Photo-Optical Instrumentation Engr., San Diego, Calif., 27 Aug. 1973 Sponsored by AEC
(UCRL-74946; Conf-730835-1) Avail: NTIS HC $3.00

The requirements and techniques for time-resolved diagnostics of laser pulses are reviewed. The advantages and limitations of applying gated image converter streak cameras to the problem of laser pulse diagnostics are discussed. The design and operation of a unique 10 p/sec time resolution streak camera is described. The compact size of the camera results primarily from the use of a microchannel tube for image intensification. Optically triggered avalanche transistor circuits provide reliable low jitter electronic operation of the streak tube. The S-1 photocathode response allows direct measurement of neodymium laser pulses. Examples of the uses of streak cameras for laser diagnostics and the data obtained are presented. Comments on additional applications and the development of streak cameras with extended capabilities are included. Author (NSA)

N74-14123*# California Univ., Livermore. Lawrence Livermore Lab.
MICROWAVE ROTATIONAL SPECTROSCOPY: A PHYSICAL TECHNIQUE FOR SPECIFIC POLLUTANT MONITORING
L. W. Hrubesh 4 Jun. 1973 14 p refs Presented at Tech. Conf. on Observation and Meas. of Atmospheric Pollution, Helsinki, Finland, 30 Jul. 1973 Sponsored by AEC
(NASA Order L-75902; Contract EPA-IAG-D179(D))
(NASA-CR-136475; UCRL-74603; Conf-730720-1) Avail: NTIS HC $3.00 CSCL 14B

An attempt was made to present substantial evidence that microwave rotational spectroscopy can be developed for use in air pollution monitoring. Work with the diode-cavity spectrometer shows it to be capable to detecting small concentrations on NO2, SO2, H2,CO, and NH3 gas with very high specificity.
NSA

N74-14124# California Univ., Livermore. Lawrence Livermore Lab.
CHARACTERISTICS OF PHOTOGRAPHIC PLATES AT 1060 NM
C. H. Dittmore and H. Joonsar Aug. 1973 23 p refs Presented at Electro-Optical Systems Design Conf., New York, 18 Sep. 1973 Sponsored by AEC
(UCRL-75047; Conf-730930-2) Avail: NTIS HC $3.25

The results of an investigation of the characteristics of Kodak emulsion type I-Z for use in neodymium laser diagnostics are described. Calibration of this emulsion, proper darkroom techniques for acceptably hypersensitizing large numbers of these plates, and certain sensitometric comparisons are presented.
Author (NSA)

N74-14125# Picatinny Arsenal, Dover, N.J.
A NOVEL METHOD FOR SELECTING ULTRASONIC TRANSDUCERS TO INSPECT TUBULAR-SHAPED PARTS Final Report, May - 30 Jun. 1973
Henry Hartmann Jun. 1973 43 p refs
(AD-767244; PA-TR-4531) Avail: NTIS CSCL 14/2

The report contains guidance for the proper selection of ultrasonic transducers to be used for inspecting tubular-shaped parts. Specific recommendations cover transducer shape, size and focal length. There are general recommendations for transducer frequency. GRA

N74-14126# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF PATTERN RECOGNITION OF AIRCRAFT ATTITUDES INDICATOR DISPLAYS M.S. Thesis
Robert Parker Bateman Jun. 1973 54 p refs
(AD-768345; GA/EE/73-3) Avail: NTIS CSCL 01/4

Spatial disorientation accident statistics are reviewed, along with unsuccessful attempts to prevent these aircraft accidents. The lack of a theoretical basis for flight instrument design is noted. A systems approach to the problem is proposed, which requires a knowledge of the human visual system. It is suggested that attitude indicator displays, the interface between man and machine, should be designed to be compatible with an internal model of spatial position. Orientation in space by the use of flight instruments is identified as a pattern recognition problem. A Fourier transform model of the human visual system is used to evaluate and classify attitude indicator displays. An algorithm is proposed for separating patterns. (Modified author abstract) GRA

N74-14127# Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
PHOTOGRAPHIC MEASUREMENT OF PARTICULATE SURFACE CONTAMINATION Technical Report, Oct. 1971 - Oct. 1972
O. Hamberg 31 Jul. 1973 50 p refs
(Contract F04701-73-C-0074)
(AD-768339; TR-00474(4901-01)-2; SAMSO-TR-73-308) Avail: NTIS CSCL 22/2

The particulate surface cleanliness of spacecraft is important to the proper functioning of certain spacecraft devices. The report reviews the limitations of some surface contamination measurements currently used, and shows how an approach based on the use of macrophotography has some inherent advantages over the usual methods for field measurement of assembled spacecraft. These advantages are that no contact with sensitive surfaces is required, the measurement is direct, and a permanent record is provided. The results of an experiment which compares particle visibility and sizing using 4X macrophotography with 37X photomicrography are provided. These results, based on the use of available equipment, indicated that macrophotography with non-optimized equipment provided reasonable accuracy down to 16 microns and that further refinement might allow the measurement of smaller particle sizes. Author (GRA)

N74-14128# Naval Postgraduate School, Monterey, Calif.
CALIBRATION OF FLOW NOZZLES USING TRAVERSING PITOT-STATIC PROBLEMS
Raymond P. Shreeve Jul. 1973 34 p refs
(AD-767696; NPS-57SF73071A) Avail: NTIS CSCL 14/2

A description is given of a method for calibrating flow nozzles used in compressor testing which is insensitive to flow variations during a survey. A computer program to reduce hand-recorded data from manometers is described which uses a compressible flow expression whose derivation is included in the first appendix. This appendix gives forms of the statement of continuity along a streamline when limiting values of the density and velocity are used to non-dimensionalize these parameters. The technique has been found to simplify the writing of computer programs for analyzing measurements from turbomachines, and to generally simplify analyses of flows that can be taken to be adiabatic. (Modified author abstract) GRA

N74-14129# Harry Diamond Labs., Washington, D.C.
THE FLUIDIC LOAD CELL
Tadeusz M. Drzewiecki Jun. 1973 32 p refs
(DA Proj. 1T0-61101-A-91A)
(AD-768094; HDL-TR-1622) Avail: NTIS CSCL 14/2

Fluidic load cells have been designed and developed by the Harry Diamond Laboratories, based on fluidic strain gage concepts evolved at these Laboratories. Applications for these fluidic type cells include force measurements in highly incendiary environments and direct control system operation on a pneumatic or hydraulic assembly line. The load cell consists of three main parts - a structural member to establish a relationship between load and deformation, a fluidic strain gage to produce a fluidic signal as a function of the deformation, and a three-stage laminar proportional amplifier gain block to raise the strain-gage output to a useful level. The load cells built have load ranges of about 0 to 20 kN with a discrimination of about 1 percent of full scale in compression; typical full-scale output pressure of the devices built is about 30 Pa at a 20 kN load. The output is fairly linear; thus, it can be used directly as indication of the load magnitude. Load-cell designs have been conceived, although

not implemented for operation in tension and in both tension and compression. Author (GRA)

N74-14130# Radio Corp. of America, Burlington, Mass. Aerospace systems Div.
EQUATE: NEW CONCEPTS IN AUTOMATIC TESTING
J. Kelly and P. M. Toscano 1973 11 p refs Presented at the Autom. Support Systems Conf., Philadelphia, 13-15 Nov. 1972
(Contract DAAB05-71-C-2461)
(AD-767042) Avail: NTIS CSCL 14/2

The EQUATE is a computer controlled automatic test system for use in the performance of acceptance testing on a wide variety of circuits, assemblies and systems and the on-line generation, editing and validation of test programs. The system is designed for use by the engineer or technician inexperienced in computer programming. The computer is used to control the generation of UUT(Unit Under Test) waveforms and analyze UUT response signals. In this manner both standard and nonstandard waveforms may be generated by one general purpose device. All waveforms and normal parameters are measured and analyzed. Special design features of EQUATE will be presented, such as the optical dial and meter reader and the UUT control driver whose functions are to reduce operator participation in the acceptance tests. Conclusions will include a summary contracting EQUATE with classic ATE designs. GRA

N74-14131# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
PROJECTION-VIEWER FOR MICROSCALE AERIAL PHOTOGRAPHY Final Report
Robert C. Aldrich, James VonMosch, and Wallace Greentree 1972 5 p
(PB-223064/7; FSRN-PSW-277) Avail: NTIS HC $3.00 CSCL 14E

A low cost projection viewer has been developed to enlarge portions of microscale aerial photography. These pictures can be used for interpretation or mapping, or for comparison with existing photographs, maps, and overlays to monitor environmental changes. The projection viewer can enlarge from 2.5 to 20 times, and can be calibrated so that maps may be drawn with a minimum of distortion. Author (GRA)

N74-14132# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF TEMPERATURE COMPENSATION AND A NEW HOT-WIRE ANETOMETRIC SENSOR FOR MEASURING FLOW VELOCITY
A. L. Grokholskii and N. I. Tkachev 27 Sep. 1973 11 p refs Transl. into ENGLISH from Tr. Akad. Navuk BSSR, Inst. Teplo- i Massoobmena (Minsk), v. 1, 1972 p 393-397
(AF Proj. G101)
(AD-767960; FTD-HT-23-34-74) Avail: NTIS CSCL 14/2

Determining the velocity of turbulent nonisothermal fluxes of gases and liquids by the hot-wire anemometer involves perfecting the methods of temperature compensation and the development of new designs for hot-wire anemometric sensors. The problem of eliminating errors caused by the temperature turbulence of the flow is still unsolved. A new method is proposed for temperature compensation directly in the studied zone of the flow, based on the use of a two-terminal thermoelectric sensor of a hot-wire anemometer. GRA

N74-14070* Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
CHARACTERISTICS OF REMOTE SENSING SYSTEMS
Ralph W. Kiefer *In* Mich. State Univ. Proc. of the Conf. on Pract. Appl. of Remote Sensing May 1973 p 7-8 (For availability see N74-14068 05-13)
CSCL 14E

N74-14074* Daedalus Enterprises, Inc., Ann Arbor, Mich.
REVIEW OF OPERATIONAL APPLICATIONS OF INFRARED AND MULTISPECTRAL SCANNERS

N74-14351 Elektronik-System G.m.b.H., Munich (West Germany).
TRENDS TOWARDS STANDARDIZED SOFTWARE AND HARDWARE FOR TEST SYSTEMS
B. Eichenauer, M. Mall, and G. Schweizer (Dornier-System G.m.b.H.) *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 20 p refs (For availability see N74-14345 05-21)

N74-14473* Imperial Coll. of Science and Technology, London (England).
FURTHER CONSIDERATIONS OF SPALLATION EFFECTS
Clive Dyer *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 83-96 (For availability see N74-14465 05-29)
CSCL 20B

N74-14517* Wisconsin Univ., Madison. Space Science and Engineering Center.
ON THE CAPABILITIES OF THE SPIN-SCAN IMAGING TECHNIQUE
T. Gehrels, V. E. Suomi, and R. J. Krauss *In* Ariz. Univ. Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 49-53 refs Repr. from Space Res., v. 12, 1972 p 1765-1769 Presented at COSPAR Meeting, Seattle, Dec. 1971 (For availability see N74-14509 05-30)
CSCL 14E

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection.

N74-14133* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVACUATED DISPLACEMENT COMPRESSION MOLDING Patent
Wilbur C. Heier, inventor (to NASA) Issued 18 Dec. 1973 8 p Filed 11 Nov. 1971 Supersedes N72-21487 (10 - 12, p 1618)
(NASA-Case-LAR-10782-1; US-Patent-3,780,151; US-Patent-Appl-SN-197689; US-Patent-Class-264-102) Avail: US Patent Office CSCL 13H

A process for molding long, thin-wall tubular bodies from thermosetting plastic molding compounds is described. The tubular bodies produced may have body lengths several times the diameters. The application of the process for manufacturing rocket engine cases and nozzles is discussed. The advantages of the system over other methods of circular tube manufacture are analyzed. P.N.F.

N74-14134 Pennsylvania Univ., Philadelphia.
STABILITY OF ROTOR-BEARING SYSTEMS WITH GENERALIZED SUPPORT FLEXIBILITY AND DAMPING, INCLUDING THE INFLUENCE OF AERO-DYNAMIC CROSS-COUPLING Ph.D. Thesis
Ronald Eugene Warner 1973 231 p
Avail: Univ. Microfilms Order No. 73-24235

The stability of the flexible single mass rotor, acted on by motion induced forces due to aerodynamic cross-coupling and supported most generally by tilting pad bearings which are in turn mounted on flexible, damped supports is discussed. The rotor is modeled as a flexible, symmetrical single mass rotor with mass-less journals, supported at each end by identical tilting pad bearings with finite pad mass and inertia. The pads are capable of tilting in the transverse plane. The pads are carried in a support ring of finite mass, which in turn is supported by a spring system and a 360 deg squeeze film bearing. It is

can be made entirely stable from the standpoint of oil whip by proper bearing support design. Dissert. Abstr.

N74-14135*# Michigan Univ., Ann Arbor. Dept. of Electrical and Computer Engineering.
AUGMENTATION OF MACHINE STRUCTURE TO IMPROVE ITS DIAGNOSABILITY
Lo Hsieh Jul. 1973 88 p refs
(Contract NGR-23-005-463)
(NASA-CR-136497:Rept-010261-6-T; SEL-TR-71) Avail: NTIS HC $6.50 CSCL 14D

Two methods of augmenting the structure of a sequential machine so that it is diagnosable are presented. The checkable (checking sequences) and repeated symbol distinguishing sequences (RDS) are discussed. It was found that as few as twice the number of outputs of the given machine is sufficient for constructing a state-output augmentation with RDS. Techniques for minimizing the number of states in resolving convergences and in resolving equivalent and nonreduced cycles are developed. K.M.M.

N74-14136*# Michigan Univ., Ann Arbor. Dept. of Electrical and Computer Engineering.
THEORY OF RELIABLE SYSTEMS Final Technical Report, May 1971 - Jun. 1973
J. F. Meyer Jul. 1973 52 p refs
(Grant NGR-23-005-463)
(NASA-CR-136498; Rept-010261-8-T; SEL-TR-73) Avail: NTIS HC $4.75 CSCL 14D

The analysis and design of reliable systems are discussed. The attributes of system reliability studied are fault tolerance, diagnosability, and reconfigurability. Objectives of the study include: to determine properties of system structure that are conducive to a particular attribute; to determine methods for obtaining reliable realizations of a given system; and to determine how properties of system behavior relate to the complexity of fault tolerant realizations. A list of 34 references is included. K.M.M.

N74-14137# Aeronautical Research Labs., Melbourne (Australia).
OPERATOR EFFECTS IN NDI. PART 2: FACTORS AFFECTING THE ASSESSMENT OF PERFORMANCE
H. R. Chinquan and I. G. Scott Feb. 1973 21 p refs
(ARL/Met-Note-87-Pt-2) Avail: NTIS HC $3.25

Possible effects of the form of reference defect and the nondestructive inspection (NDI) technique on operator performance are discussed. Methods of producing reference defects are examined along with some of their physical characteristics. The diagnostic nature of NDI process is emphasized and the consequent effect on the interpretation of experiment results is discussed. The findings are used to predict possible effects in measured operator performance. Author

N74-14138*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED CIRCUMFERENTIAL SHAFT SEAL FOR AIRCRAFT GEAR TRANSMISSIONS
Lawrence P. Ludwig and Thomas N. Strom Washington Dec. 1973 14 p
(NASA-TN-D-7130; E-7133) Avail: NTIS HC $2.75 CSCL 11A

Operation under simulated aircraft transmission conditions of speeds to 2850 m/min (9350 ft/min), lubricant temperatures to 394 K (250 F), shaft radial runouts to 0.254 mm (0.010 in.) F.I.R. (full indicator reading), and pressure differentials to 1.03 N/cm2 (1.5 psi) revealed that conventional circumferential seals leaked excessively. Modifying the conventional seal by adding helical grooves to the seal bore reduced leakage rates to within the acceptable level of 10 cm3/hr. The leakage rate of this modified seal was not significantly affected by lubricant flooding or by shaft radial runout. Author

N74-14139*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION BEHAVIOR OF GLASS AND METALS IN CONTACT WITH GLASS IN VARIOUS ENVIRONMENTS
Donald H. Buckley Washington Dec. 1973 15 p refs
(NASA-TN-D-7529; E-7623) Avail: NTIS HC $2.75 CSCL 11B

Sliding friction experiments have been conducted for heat-resistant glass and metals in contact with glass. These experiments were conducted in various environments including vacuum, moist air, dry air, octane, and stearic acid in hexadecane. Glass exhibited a higher friction force in moist air than it did in vacuum when in sliding contact with itself. The metals, aluminum, iron, and gold, all exhibited the same friction coefficient when sliding on glass in vacuum as glass sliding on glass. Gold-to-glass contacts were extremely sensitive to the environment despite the relative chemical inertness of gold. Author

N74-14140*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PARTS, MATERIALS, AND PROCESSES EXPERIENCE SUMMARY, VOLUME 2
Washington NASA 1973 381 p refs Previously announced as NASA-CR-114391; N72-18502
(Contract NAS2-6060)
(NASA-SP-6507-Vol-2; NASA-CR-114391) Avail: NTIS HC $8.00 CSCL 13H

This summary provides the general engineering community with the accumulated experience from ALERT reports issued by NASA and the Government-Industry Data Exchange Program, and related experience gained by Government and industry. It provides expanded information on selected topics by relating the problem area (failure) to the cause, the investigation and findings, the suggestions for avoidance (inspections, screening tests, proper part applications, requirements for manufacturer's plant facilities, etc.), and failure analysis procedures. Diodes, integrated circuits, and transistors are covered in this volume. Author

N74-14141*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IMPROVED BONDING METHOD IN THE MANUFACTURE OF CONTINUOUS REGRESSION RATE SENSOR DEVICES Patent Application
William M. Haraway, Jr., Walter J. Dale, and Edwin A. McErlean, inventors (to NASA) Filed 12 Dec. 1973 17 p
(NASA-Case-LAR-10337-1; US-Patent-Appl-SN-424038) Avail: NTIS HC $3.00 CSCL 13H

A bonding technique in the manufacture of continuous regression rate sensor devices is described. The process involves the use of phenolic resins as bonding agents that are manufactured from phenolic-graphite or phenolic-nylon materials. The application of the process to the manufacture of materials for nose cones and structural members of space missiles is discussed. NASA

N74-14142*# Weston Instruments, Inc., College Park, Md.
THERMALLY OSCILLATING ACTUATORS Final Report
29 May 1973 4 p
(Contract NAS5-22108)
(NASA-CR-132788) Avail: NTIS HC $3.00 CSCL 13I

The actuator was redesigned to accommodate the new thermal motor for the Helios flipper. This design retained the basic configuration and dimensions of the original actuator. Changes were made primarily to the cradle and motor assembly. Because of the increased dimensions of the thermal motor, it was necessary to increase the diameter of the pellet case and associated parts including the back off spring and the piston return spring. The new springs were designed to yield the same spring rate differential as the originals. The design effort resulted in a new top assembly and approximately twenty sub-assembly and detail drawings. A list of drawings generated by EMR is attached. Author

N74-14143*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INTERACTION OF SOME EXTREME-PRESSURE TYPE LUBRICATING COMPOUNDS WITH AN IRON SURFACE
Donald H. Buckley Washington Dec. 1973 17 p refs
(NASA-TN-D-7528; E-7600) Avail: NTIS HC $2.75 CSCL 11H

An iron surface was exposed to the extreme-pressure type lubricant benzyl chloride, dichlorophenyl phosphine, dichlorophenyl phosphine sulfide, ophenyl phosphine oxide. Iron, in the sputter-

cleaned state, was exposed to these materials statically and during dynamic friction experiments. With benzyl chloride only chlorine adsorbed to the surface, and with dichlorophenyl phosphine no adsorption occurred, while the addition of sulfur to that same molecular structure resulted in the promotion of carbon and chlorine adsorption. substitution of oxygen for sulfur in the dichlorobenzyl phosphine molecule resulted in carbon, chlorine, and oxygen adsorption. With none of the phosphorus containing molecules was phosphorus detected on the surface. Sliding in an atmosphere of benzyl chloride promoted adsorption of chlorine to the iron surface. Increases in load resulted in a decrease in the surface concentration of iron chloride. Author

N74-14144*# Mechanical Technology, Inc., Latham, N.Y.
EVALUATION OF A SERIES HYBIRD THRUST BEARING AT DN VALUES TO THREE MILLION. 1: ANALYSIS AND DESIGN Final Report
A. Gu, M. Eusepi, and L. W. Winn Washington NASA Jan. 1974 54 p refs
(Contract NAS3-16740)
(NASA-CR-2366; MTI-73TR10) Avail: NTIS HC $3.50 CSCL 13I

The analysis and design are presented of a hybrid bearing consisting of a 150-mm ball bearing and a centrifugally actuated, conical, fluid film bearing fitting an envelope with an outer radius of 86.4 mm (3.4 in.) and an inner radius of 71 mm (2.8 in.). The bearing analysis, combined with available torque data on ball bearings, indicates that an effective speed split between the ball and fluid-film bearings of 50 percent may be expected during operation at 20,000 rpm and under an axial load of 17,800 newtons (4000 lbs.). This speed split can result in a ten-fold increase in the life of the ball bearing when compared to a simple ball bearing system operating under similar conditions. Author

N74-14145# Bendix Corp., Kansas City, Mo.
JOINING MAGNETIC ALLOY 49Fe-49Co-2V TO 304L STAINLESS STEEL
D. M. Jarboe Aug. 1973 18 p refs
(Contract AT(29-1)-613)
(BDX-613-936) Avail: NTIS HC $4.00

A vacuum furnace brazing process using oxygen-free copper as the filler metal has been developed for joining 49Fe-49Co-2V soft magnetic alloy and 304L stainless steel. The process eliminated the hot cracking problem associated with electron beam welding these materials. Joints produced by this process have withstood shear loads in excess of 2000 pounds (8896N). Author (NSA)

N74-14146# Battelle-Northwest, Richland, Wash. Pacific Northwest Labs.
HIGH TEMPERATURE METHODS FOR DISPOSAL OF CONTAMINATED METAL EQUIPMENT
H. T. Fullam Jul. 1973 47 p
(Contract AT(45-1)-2130)
(BNWL-B-277) Avail: NTIS HC $4.50

Three high temperature processes for simplifying the disposal of contaminated metal equipment were investigated: fused salt decontamination, metal meltdown under a fused inorganic slag, and metal meltdown under an inert atmosphere. It was found that contaminated stainless steel could be effectively decontaminated using oxidizing fused salts. Decontamination factors (DF's) of 1 million or better were obtained using fused sodium nitrate at 800 C and several stages of fused salt-metal contact. The process generates a large volume of contaminated salt, however, which severely limits its practical application. By melting down contaminated metal under a fused inorganic slag it was hoped that the radioactivity would be transferred to the slag phase, leaving a clean metal phase which could be cast into an ingot for uncontrolled reuse. It was found upon melting the metal that only a fraction of the fraction of the activity was transferred to the fused slag, with the major portion remaining in the metal phase. Author (NSA)

N74-14147# Atomics International, Canoga Park, Calif.
ZIRCONIUM HYDRIDE REACTOR CONTROL SYSTEM BEARING DEVELOPMENT
P. H. Horton and W. J. Kurzeka 14 Jun. 1973 115 p refs
(Contract AT(04-3)-701)
(AI-AEC-13079) Avail: NTIS HC $5.45

The technical history and development of bearings for the various SNAP reactor programs are traced from initial material selection through life testing and reactor operation. A reference bearing couple of flame-sprayed Al2O3 against carbon-graphite has successfully operated in individual tests of 20,000 hours and through a combined total of more than 120,000 hours. The self-aligning journal bearing design has provided low friction operation in temperatures to 1500 F in space vacuum (to 10 to the minus 9 power torr) without self-welding after long dwell periods. A variety of Al2O2 substrates have been used successfully for component requirements between 800 and 1500 F including Type 300 series stainless steels, Inconel 750, and tantalum-10% tungsten alloys. Author (NSA)

N74-14148# Sandia Labs., Albuquerque, N.Mex.
ANALOG COMPUTER SIMULATION OF AN OPTICAL TRACKING MOUNT
F. K. Bechtel, A. L. Shaut, and F. V. Wyatt Sep. 1973 22 p
(Contract AT(29-1)-789)
(SLA-73-802) Avail: NTIS HC $3.25

The process of improving the design of tracking mount systems requires testing with a simulation of the tracking mount system. This report describes both a model of a tracking mount system and an implementation of that model on an analog computer. Coulomb friction and saturation nonlinearities are included in the model. Comparisons between results from a particular tracking mount system and its analog computer simulation provide a basis for confidence in the simulation's validity. An example involving the effects of changing sampling rate and delay in the position loop's error sensing apparatus illustrates the use of the simulation. A performance criterion is suggested for use with adaptive design. Author (NSA)

N74-14149# Trans-Sonics, Inc., Burlington, Mass.
THE INVESTIGATION AND INTERPRETATION OF THE NATURE OF WEAR PARTICLES Progress Report, 10 May - 20 Sep. 1973
J. L. Middleton and V. C. Westcott 20 Sep. 1973 31 p
(Contract N00014-73-C-0455; NR Proj. 229-005)
(AD-768357) Avail: NTIS CSCL 13/9

During the sliding or rolling of one metal part against another, tiny metallic particles are produced. If the metal parts are lubricated by oil or grease the particles produced are of such a size that they are suspended in the oil in a colloidal manner. If one of the two metallic parts is composed of steel or alloys of steel, the metal particles generated during the wear process exhibit magnetic properties. The Ferrograph is an instrument which precipitates out these particles and deposits them on a transparent substrate. The particle sizes grade continuously along the substrate so that it is possible to examine individual particles in detail without interference from a random pile of other particles. The report surveys some of the findings about wearing systems and in large part is concerned with the correspondence between particle type and the class of mechanical part wearing. The report covers the processing and analysis of a number of oil samples furnished for this purpose. The report identifies the size, shape, and size distribution of adhesive, abrasive and fatigue-generated wear particles. Author (GRA)

N74-14150# Naval Ordnance Station, Louisville, Ky.
EVALUATION OF THE TOOLING DESIGN FOR THE PRODUCTION OF LARGE DIAMETER, THIN WALL TURBULAR SHAPES BY HYDROSTATIC EXTRUSION Final Report
G. A. Gegel, T. G. Byrer, R. J. Fiorentino, and F. A. Simonen Jul. 1973 151 p refs
(AD-767933; NOSL-MT-010) Avail: NTIS CSCL 13/9

A multi-phase program was initiated for the development of a prototype-production process for manufacturing large diameter, thin-walled tubular ordnance items by hydrostatic extrusion. The ASROC missile case was selected as a component representative of such naval ordnance items. The full-scale tooling design concepts developed in Phase 2(a) were modified and adapted to fit in Battelle's seven-inch bore hydrostatic extrusion container. The tooling design was then evaluated by extruding approximately half-scale cases from 6061 aluminum, AISI 1015 and AISI

4135 steel. Evaluation of the extruded products indicated that the dimensional requirements of the full-size ASROC could be achieved by hydrostatic extrusion. An economic analysis indicated that the estimated production cost for a full-size ASROC motor case could be reduced as much as 18%, based on quantities of 500, to 24%, based on quantities of 10,000, if produced by hydrostatic extrusion instead of shear forming. Author (GRA)

N74-14151# Products Research and Chemical Corp., Burbank, Calif.
FUEL AND HIGH TEMPERATURE RESISTANT CHANNEL SEALANT SUITABLE FOR 15 MIL GAPS Final Report, 1 Jan. - 1 Aug. 1973
Hakam Singh, Robert N. Gilliland, John McShane, and Lester Morris Aug. 1973 26 p refs
(Contract N00019-73-C-0251)
(AD-767787) Avail: NTIS CSCL 11/1

A formulation of a cyanosiloxane polymer has been made which meets the performance requirements of MIL-S-81323A, Class A, channel sealant for sealing 15-mil gaps at temperatures up to 350F. Expansion and contraction of channel sealant during cycling was reduced by increasing pigmentation and by using solvent-fractionated polymer. Low-temperature flexibility and adhesion retention was improved by using a silane-treated pigment and replacing the epoxy with a phenolic resin. By changing pigment types and quantities, pH was varied from 4.1 to 7.7, and corrosion disappeared. Chromate pigments effectively inhibited corrosion and were incorporated into the formulation. (Modified author abstract) GRA

N74-14152# Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering and Astronautical Sciences.
THERMOELASTIC INSTABILITY IN A SEAL-LIKE CONFIGURATION Annual Report
Ralph A. Burton, Virupax Nerlikar, and Rao Kilaparti 1 Sep. 1973 119 p refs
(Contract N00014-67-A-0356-0022; NR Proj. 229-001)
(AD-768196) Avail: NTIS CSCL 11/1

The report comprises five independent studies leading progressively to an understanding of the thermoelastic behavior of sliding contacts. To be specific it deals with a seal-like configuration consisting of two tubes, contacting end to end. The effects of materials variation, oxide films and initial departures from flatness are investigated; and, as will be shown, the conditions under which surface contact departs from its initial state are delineated. The ultimate high-sliding-speed configuration of isolated contact patches separated by non contacting surfaces is treated, and both contact temperature of the patches and leakage in the gaps between are dealt with analytically. To the extent that the simplified geometry and materials choices represent real seals, the analytical results lead toward design criteria for practical applications. Author (GRA)

N74-14153# Battelle Columbus Labs., Ohio. Metals and Ceramics Information Center.
METALLURGY OF FUSION-WELD REPAIR
Robert M. Evans Aug. 1973 68 p refs
(Contract DSA900-74-C-0616)
(AD-768210; MCIC-73-15) Avail: NTIS CSCL 13/5

The report examines the important metallurgical factors that must be considered when planning and executing a repair weld. The implications of the effect of repair welding on the more complex high-strength heat treatable alloys and heat-resistant alloys are described. The possible deleterious effects of repair welding in terms of the metallurgy are also covered. Then the specific considerations applicable to each of several base-metal systems are examined. The alloys covered include steels of all types, aluminum alloys, nickel-base alloys, and titanium alloys. Following sections on types of defects and welding metallurgy, a final section is devoted entirely to examples of repair welding problems which have been solved and studies made to determine the effect of repair welding on the properties of weldments. Author (GRA)

N74-14154# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
FUELS AND LUBRICANTS Final Report on Test Operations Procedure
30 Oct. 1973 31 p refs
(AD-768209; TOP-2-2-701) Avail: NTIS CSCL 14/2

The report describes a method for evaluating Army-procured fuel and lubricant compatibility with Army vehicles and a method for sampling and spectrometric analysis of lubricants for symptoms of metal wear or contamination. It describes equipment and facilities and basic test requirements. Included are test procedures for octane and cetane requirements; engine, transmission, and vehicle compatibility; cold starting; hydraulic, gear oil, and grease systems; and spectrometric oil analysis. A chart of typical fuels and lubricants for Army ground vehicles and equipment is included. (Modified author abstract) GRA

N74-14155# National Materials Advisory Board, Washington, D.C.
HIGH PERFORMANCE STEEL AND TITANIUM CASTINGS Final Report
Feb. 1973 154 p refs
(Contract DA-49-083-OSA-3131)
(AD-767726; NMAB-296) Avail: NTIS CSCL 13/8

The present state of foundry technology pertinent to the production of high performance HY-130 and HY-180 steel and titanium alloy castings is assessed. Problems encountered in current production and those anticipated in future production of large castings up to 20,000 pounds (finished weight) are discussed. Programs and approaches to resolve these problems are recommended. Factors considered were: specific melting processes and furnaces for preparing and refining molten alloys, casting design, mold and pouring practice, influence of chemical composition, impurity elements, heat treatment and other processing variables on mechanical properties of casting, present and anticipated foundry problems with specific alloys, weld repair and structural joining, scrap reclamation, and appropriate procurement specification requirements to assure attainment of desired properties and qualities in castings of all sizes. (Modified author abstract) GRA

N74-13909 Admiralty Surface Weapons Establishment, Portsmouth (England).
RELIABILITY RELATED TO COMPUTER AIDED CIRCUIT DESIGN: A USER'S VIEW
N. A. Walter and A. A. Kaposi *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 10 p (For availability see N74-13906 05-10)

N74-13910 Radio Corp. of America, Moorestown, N.J. Government and Commercial Systems Div.
RELIABILITY AND COMPUTER AIDED DESIGN
James G. Smith *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 11 p refs (For availability see N74-13906 05-10)

N74-13911 Technical Univ. of Denmark, Lyngby.
COMPUTER AIDED DESIGN FOR MAXIMUM PRODUCTION YIELD OR MAXIMUM RELIABILITY
P. W. Becker and F. Jensen (Storno A/S, Copenhagen, Denmark) *In* AGARD Computer Aided Design for Electron. Circuits Oct. 1973 14 p refs (For availability see N74-13906 05-10)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State.

N74-14156 Polytechnic Inst. of Brooklyn, N.Y.
HIGH RESOLUTION SATURATION SPECTROSCOPY AND FREQUENCY STABILIZATION OF CO2 LASERS Ph.D. Thesis
Robert B. Keller 1973 83 p
Avail: Univ. Microfilms Order No. 73-24772

The experimental investigation of the inverted Lamb dip in SF6 with application as a frequency reference for stabilization of the CO2 laser is discussed. The following is a description of the results obtained: (1) inverted Lamb dip widths (full width at half maximum) have been observed which are one part in 10 to the 9th power of the laser frequency. (2) an error signal

derived from the Lamb dip is used to stabilize the laser to the dip central frequency. The error signal, or discriminant, has been compared to theory and agreement is favorable, and (3) by stabilizing two lasers against two different dips coincident with the P(16) tuning range of the CO2 laser, the frequency separation between these dips has been determined. Dissert. Abstr.

N74-14157 Utah Univ., Salt Lake City.
METAL CARBONYL LASERS, PART 1. FLUORESCENCE MEASUREMENT TECHNIQUES, PART 2 Ph.D. Thesis
George Wyatt Rhodes 1973 73 p
Avail: Univ. Microfilms Order No. 73-23101

Three metal carbonyl compounds were evaluated as possible metal vapor laser candidates. Both the nickel and iron compounds exhibited proof of stimulated emission while the chromium compound did not. The design and construction of a novel TEA laser was accomplished. The design and construction of a real time display - data processing technique for fast fluorescence lifetime determinations was accomplished by the marriage of a signal averager to a sampling oscilloscope. The technique was found to be useful for the rapid acquisition of voluminous amounts of accurate data. Dissert. Abstr.

N74-14158 Houston Univ., Tex.
POLARIZATION AND FREQUENCY CHARACTERISTICS OF A SINGLE RESONANT MODE IN A DUAL-POLARIZED He-Ne GAS RING LASER Ph.D. Thesis
Virgil Eugene Sanders 1973 82 p
Avail: Univ. Microfilms Order No. 73-22930

Experimental observation of simultaneous laser oscillation of four traveling-wave eigenstates of polarization of a single electromagnetic resonant mode in an optically non-reciprocal, anisotropic, ring laser is reported. Theoretical expressions are calculated, for the frequency and polarization characteristics of the four eigenstates of the single resonant mode in terms of the elements of the passive cavity. A comparison between the experimentally observed and theoretically calculated polarization and frequency characteristics of the eigenstates confirm the validity of the analysis. In addition, the simultaneous beat signals yield a comparison of the nonlinear mode coupling effects associated with eigenstates from opposite directions as opposed to those from the same direction. Dissert. Abstr.

N74-14159 Colorado Univ., Boulder.
THE THEORY OF LASER-GENERATED THERMOELASTIC SHOCK WAVES IN LIQUIDS Ph.D. Thesis
Gangadaran Siva Bushanam 1973 153 p
Avail: Univ. Microfilms Order No. 73-23238

The generation of pressure waves by laser heating in an optically absorbing dye was investigated. The conversion of energy from transient laser heating to an acoustic wave is considered. As a laser pulse enters an absorbing dye, its energy is converted into heat. Part of the energy appears as elastic energy in the form of pressure caused by a small expansion in the liquid during the laser pulse. Computational results show an increasing amplitude pressure pulses as the moving saturation front propagates. Comparison experiments were conducted only with the free surface boundary. Dissert. Abstr.

N74-14160 Washington Univ., Seattle.
NONLINEAR PHENOMENA IN INDIUM ANTIMONIDE PRODUCED BY CARBON-DIOXIDE LASER IRRADIATION Ph.D. Thesis
Hans Jacob Fossum 1973 118 p
Avail: Univ. Microfilms Order No. 73-22567

Irradiation of InSb with CO2 laser light produces high excess carrier densities such as plasmas, by two-photon excitation of electron-hole pairs. Such plasmas are unique because uniform carrier distributions are obtained throughout the bulk of small samples. Their generation does not require an applied electric field. The production and properties of plasmas in n-InSb single crystals are described in detail. The diagnostics employ photoconductivity, infrared absorption, and recombination radiation measurements, at liquid N2 and He temperatures, with both 10.6 and 9.6 micron irradiation wavelengths. Dissert. Abstr.

N74-14161 Washington Univ., Seattle.
AN APPLICATION OF HOLOGRAPHY TO THE STUDY OF AIR-WATER TWO-PHASE CRITICAL FLOW Ph.D. Thesis
Young Jai Lee 1973 170 p
Avail: Univ. Microfilms Order No. 73-22586

An experimental study dealing with the measurement of drop size and drop velocity for two-phase air-water critical flow. A new photographic technique employing a laser as the light source and using holography to record the results of the photography were important features of this work. The use of a large aperture improved the quality of the photographs to a considerable degree. The ruby laser employed was able to produce double pulses separated by a minimum of 5 microseconds which allowed for the calculation of the velocity of the drops. The drop size distribution for the system studied both at critical flow and for flows at below the critical value were obtained by using single pulse holograms. It was possible to operate only at quality levels above 0.95. This was also true for the velocity measurements which employed the use of the double pulse laser output.
Dissert. Abstr.

N74-14162 Polytechnic Inst. of Brooklyn, N.Y.
THE SEMICLASSICAL THEORY OF GASEOUS DIPOLAR MEDIA WITH APPLICATION TO THE GAS LASER Ph.D. Thesis
Anthony Acampora 1973 397 p
Avail: Univ. Microfilms Order No. 73-24738

A general model of the active medium and a description of its interaction with an electromagnetic field which can, in principle, be applied to investigate all aspects of laser phenomena within the semiclassical regime is provided. The concept of the dipole gas is introduced and studied by generalizing the Klimontovich approach, which has been applied with success to study the behavior of ionized gases. A suitable dipole state-space is defined such that each point in this space defines a particular internal dipole wavefunction as well as classical center-of-mass motion. An expression for the exact microscopic density of the dipoles in state-space is formulated and the dynamics of the density is related to the microscopic electromagnetic field via Schrodinger's wave equation and Lorentzian forces. Employing this density as a source term in the microscopic field equations provides for a complete microscopic description of the dipole-field ensemble within the semiclassical regime. Dissert. Abstr.

N74-14163 Polytechnic Inst. of Brooklyn, N.Y.
THEORY OF LASER OSCILLATION, STABILITY AND FLUCTUATIONS AND THE EXTERNAL ABSORPTION CELL METHOD OF FREQUENCY STABILIZATION AND LAMB DIP SPECTROSCOPY Ph.D. Thesis
Yih-Bute Yu 1973 270 p
Avail: Univ. Microfilms Order No. 73-22951

Single mode laser oscillation with homogeneously broadened amplifying and absorbing media in a common cavity is studied. Depending on the range of parameters, the threshold condition indicates two, one, or no steady state solutions. We have investigated the stability of each of these solutions against amplitude perturbations. A new approach to the theory of a high intensity gas layer is presented. An analytic expression for the intensity as a function of the offset from the atomic line center is obtained in the neighborhood of the center of the Lamb dip. A theory of the external absorption cell method of frequency stabilization and high-resolution Lamb dip spectroscopy was developed. Implicit expressions are obtained for all harmonics of the modulation frequency for arbitrary field intensity in the detector current and an analytic expression for the first harmonic third order in field strength for a flat Doppler line.
Dissert. Abstr.

N74-14164# Carleton Univ., Ottawa (Ontario). Dept. of Electronic and Materials Engineering.
THE CONSTRUCTION AND OPERATION OF A TRANSVERSE EXCITED CO2 LASER AT PRESSURES ABOVE ONE ATMOSPHERE
David John Hidson Oct. 1973 181 p refs
Avail: NTIS HC $11.25

The construction and operation of a high pressure, transverse excited CO2 laser is described. The laser was constructed from a 1 m long lucite tube 1/4 inch thick built to hold 10 Atm. The electrodes were 60 cm long; the amode consisted of 113 stainless steel pins spaced 5 mm apart and the cathode was a

curved copper plate. The optical cavity was internal. A 1/4 inch thick germanium etalon and a 5 m radius brass mirror sealed the ends of the laser tube and formed the cavity simultaneously. The power source was a four-stage Marx generator capable of producing high speed (20 ns) voltage pulses from 96 kv to 288 kv. This pulse was transmitted to the electrodes by aluminum plates forming a transmission line. Output peak powers measured by a photon drag detector were between 3 and 25 MW, and laser action was detected at all pressures up to 6 Atm. Maximum energies of 0.8 J were detected. Actual efficiencies were of the order of 5% or less. Author

N74-14165# Defence Standards Labs., Maribyrnong (Australia).
THE DISTORTION OF A 10.6 MICRON LASER BEAM IN THE ATMOSPHERE
B. C. H. Wendlandt Oct. 1973 8 p refs
(TN-315) Avail: NTIS HC $3.00

The development of recent theoretical and experimental work relating to the propagation of a 10.6-micron laser beam through the atmosphere is reviewed. Various theories are examined to find the one best suited for predicting thermal distortion of high powered laser beam over long distances. Author

N74-14166*# Humphreys Corp., Concord, N.H.
SEEDED GAS THRUSTERS AND RELATED SYSTEM COMPONENTS Final Report
John W. Poole and Merle L. Thorpe Washington NASA Jan. 1974 27 p
(Contract NAS3-17192)
(NASA-CR-2364) Avail: NTIS HC $3.00 CSCL 20E

A program involved with the construction and test of a number of laser heated thrusters is described. These thrusters, with a cavity approximately 23 cm long and 3.5 cm in i.d., are to be tested by NASA at a later date with a laser beam focused through the throat to heat hydrogen propellant containing an opacifier. The heated propellant exhausts through a supersonic nozzle with a 0.6 cm throat at 3000 C. Thrust stands and control systems were furnished with the thrusters. The report describes radio frequency plasma heated hot and cold flow simulation tests by the contractor. Author

N74-14167# California Univ., Livermore. Lawrence Livermore Lab.
FOUR-TEMPERATURE KINETIC MODEL FOR A CO2 LASER AMPLIFIER
R. J. Harrach and T. H. Einwohner 30 May 1973 54 p refs
(Contract W-7405-eng-48)
(UCRL-51399) Avail: NTIS HC $4.75

A four-temperature (4-T) kinetic model is derived for a CO2 electric discharge laser amplifier, taking account of the effects of additive gases nitrogen and helium, radiation terms, and the temperature dependence of vibrational energy transfer rates. The characteristic temperatures of the 4-T model are the gas translational temperature, two separate vibrational temperatures for CO2, and one vibrational temperature for nitrogen. One of the CO2 temperatures refers to the asymmetric stretch mode, and the second to the bending and symmetric stretch modes, which are assumed to be equilibrium. The specific case of electric-discharge initiation by a pulse of high energy electrons is studied, allowing for electronic excitation of nitrogen molecules and all three modes of CO2. The excitation rate coefficients are not derived, but rather are required input parameters for the model. Examples of results predicted by the 4-T model are given. Author (NSA)

N74-14168# Los Alamos Scientific Lab., N.Mex.
LASER-STIMULATED CHEMISTRY IN CHEMICAL LASERS
C. P. Robinson 1973 9 p Presented at the 7th Intern. Conf. on Photochemistry, Jerusalem, 29 Aug. 1973
(Contract W-7405-eng-36)
(LA-UR-73-1261; Conf-730834-1) Avail: NTIS HC $3.00

The photoignition of chemical lasers has been a standard technique for uniform-volume initiation using flash lamps and ultraviolet lasers. Recent work on stimulating chemical reactions with infrared lasers offers new possibilities for laser ignition. A review of recent experimental work of the chemical laser research and development group is presented. Author (NSA)

N74-14169# Los Alamos Scientific Lab., N.Mex.
HIGH-ENERGY, SHORT-PULSE GAS LASER SYSTEMS
C. Fenstermacher 1973 38 p refs Sponsored by AEC
(LA-UR-73-1396) Avail: NTIS HC $4.00

The status of high-pressure CO2 lasers is discussed and compared with other high-energy short-pulse laser systems. The discussion is divided into three areas: (1) pumping mechanisms, (2) short pulse generation by the oscillator, and (3) the extraction of stored energy from the amplifier stages by short pulse amplification. (MOW) Author (NSA)

N74-14170# Sandia Labs., Albuquerque, N.Mex.
COMPACT SUPER-STABLE LASERS AS LENGTH DIGITIZERS
A. Zuppero 1973 14 p refs Presented at Meeting of the Soc. of Photo-Optical Instrumentation Engr., San Diego, Calif., 27 Aug. 1973 Sponsored by AEC
(Conf-730835-2; SLA-73-5632) Avail: NTIS HC $3.00

The operation, application, and working theory of an ultrastable laser as a length digitizer is summarized. The two projects presently under way, a 1.6-km (1 mile) long laser earth-strain seismometer and a 1-cm pendulum tilt meter, each with a range of 10 to the minus 12th power to 10 to the minus 5th power strain units and radians (or acceleration g units), respectively, are detailed as examples of application. Concepts in angular measurement and servo-controlled physical dimension are reviewed. Author (NSA)

N74-14171# California Univ., Livermore. Lawrence Livermore Lab.
LASER INDUCED IMPLOSION AND THERMONUCLEAR BURN
J. H. Nuckolls 23 Jul. 1973 23 p refs Presented at 3d Workshop on Laser Interaction and Related Plasma Phenomena, Troy, N. Y., 13 Aug. 1973
(UCRL-74345-Rev-1; Conf-730836-2) Avail: NTIS HC $3.25

The following areas related to laser implosion are discussed: (1) thermonuclear burn, (2) implosion, (3) symmetry, (4) stability, (5) computer calculations, and (6) CTR applications.
Author (NSA)

N74-14172# California Univ., Livermore. Lawrence Livermore Lab.
WAVE CONVERSION AND RESONANCES IN LASER LIGHT SCATTERING
A. L. Peratt 16 Aug. 1973 6 p refs Presented at 11th Intern. Conf. on Phenomena in Ionized Gases, Prague, 10 Sep. 1973
(Contract W-7405-eng-48)
(UCRL-74974; Conf-730906-5) Avail: NTIS HC $3.00

The calculation of the differential cross section for the scattering of an electromagnetic wave in an underdense plasma is discussed. The method used is based on the derivation of a formal relation between the autocorrelations of current density and dielectric tensor. The formulation leads to expressions that are particularly simple when the plasma is in the thermal equilibrium. An enhancement of the scattering spectra because of the coupling of transverse waves and excitation of longitudinal slow wave resonances is found to result when the Doppler shift exceeds collisional frequencies when the differential scattering vector is aligned primarily perpendicular to the magnetic field.
Author (NSA)

N74-14173# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
GENERATION, SELECTION AND AMPLIFICATION OF MODE-LOCKED RUBY LASER PULSES
David Milam, R. A. Bradbury, E. S. Bliss, and C. C. Gallagher 29 Aug. 1973 40 p refs
(AF Proj. 6100)
(AD-767281; AFCRL-TR-73-0550) Avail: NTIS CSCL 20/5

A system capable of producing laser pulses of 5-20 picosecond duration and with energies of up to 40 m J is described. The system consists of a TEM (oo)-mode, mode-locked ruby laser, an external pulse selector, and two amplifiers. TEM (oo)-mode operation is obtained in the passively mode-locked oscillator by the use of a ruby rod only 2.5 mm in diameter so that the rod is the limiting aperture of the cavity. The total pulse trains

have energies of about 3 m J, while individual pulses have energies of 0.2 to 0.3 m J and are 20 to 25 psec in duration. The pulse duration can be reduced to approximately 5 psec by incorporating a telescope in the cavity. The probability of obtaining a cleanly locked pulse train exceeds 0.8 and intracavity damage is minimized due to the smooth mode profile. (Modified author abstract) GRA

N74-14174# Air Force Weapons Lab., Kirtland AFB, N.Mex.
ANTIREFLECTION COATING DESIGNS FOR 10.6-MICRON WINDOW MATERIALS Technical Report, 1 Jan. - 1 Jul. 1972
John S. Loomis Jan. 1973 166 p refs
(AF Proj. 3326)
(AD-768331; AFWL-TR-72-180) Avail: NTIS CSCL 20/5

The theory of two-layer, antireflection coatings is presented with special emphasis on the absorption in the coating and the effect of thickness variations on the reflectivity and transmitted phase front. Coating designs for 10.6-micron window materials (potassium chloride, zinc selenide, cadmium telluride, and germanium) are systematically cataloged. Author (GRA)

N74-14175# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
THEORY OF SELF-LOCKING OF LASERS WITH INHOMOGENEOUSLY BROADENED LINES
R. J. Collins and T. S. Chen Aug. 1973 52 p refs
(Contract N00014-68-A-0141-0002; NR Proj. 016-102)
(AD-767968; TR-73-03) Avail: NTIS CSCL 20/5

A theoretical model is given to describe self-locking. The semi-classical theory of Lamb for laser action has been modified to include the collisional effects on linewidth and on the nonlinear polarization. The collisional effects were included by a classical atom-atom rate. The results modify Lamb's equation for the frequencies and phases of oscillating modes. The criterion of self-locking of modes is expressed in terms of ratio of loss to unsaturated gain. Comparisons of the theoretical results and published experimental results for He-Ne and He-Cd are satisfactory. Author (GRA)

N74-14176# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
SELF-MODE LOCKING IN INHOMOGENEOUSLY-BROADENED CW LASERS
Gerald R. Willenbring Aug. 1973 144 p refs
(Contract N00014-68-A-0141-0002; NR Proj. 016-102)
(AD-767969; TR-73-04) Avail: NTIS CSCL 20/5

An experimental and theoretical discussion of self-mode locking in multimode CW gas lasers is presented. The average saturated gain profile is assumed to be nearly flat in the frequency range of the oscillating modes because the homogeneous pressure-broadened linewidth is larger than the intermode frequency spacing. For He-Ne and He-Cd(-) lasers the gain fluctuations which occur as the pulses propagate through the active medium are believed to be small since the pulse velocity has been found to be approximately the same as the group velocity associated with the average dispersion. Estimates of the recovery time for the inversion density in a He-Ne laser indicate that the gain variations are a few percent of the average gain. An experimental technique for measuring the mode phases was developed, and measurements were made on a self-locked He-Ne laser with about seven modes. The results show that the modes are not in phase, and that, for the particular laser used, one mode toward the high-frequency end of the spectrum is lagging the others in phase by about 40 degrees.
Author (GRA)

N74-14177# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
CO2 LASER-PUMPED FAR INFRARED (FIR) WAVEGUIDE LASER Report for Nov. 1972 - Mar. 1973
Dean T. Hodges, Jr. and Thomas S. Hartwick 15 Sep. 1973 15 p refs
(Contract F04701-73-C-0074)
(AD-768338; TR-0074(9230-01)-3; SAMSO-TR-73-331) Avail: NTIS CSCL 20/5

Using a hollow waveguide resonator, laser operation in the far infrared (FIR) has been observed on several transitions between 40 micrometers and 200 micrometers from methyl alcohol excited by the resonant absorption of CO2 pump laser lines. The preliminary performance characteristics of FIR waveguide lasers constructed from both metallic and dielectric tubes are discussed. For CO2 pump powers of a few watts, CW output power at the milliwatt level in the FIR waveguide lasers constructed from both metallic and dielectric tubes are discussed. For CO2 pump powers of a few watts, CW output power at the milliwatt level in the FIR was observed from waveguide laser structures only a small fraction of the size of conventional FIR laser resonators.
Author (GRA)

N74-14178# Ford Motor Co., Dearborn, Mich.
WAVEGUIDE EXPERIMENTS IN PbTe THIN FILMS AND THE TUNING CHARACTER OF PbTe DIODE LASERS Quarterly Technical Report, 1 Jul. - 30 Sep. 1973
S. L. McCarthy, W. H. Weber, M. Mikkor, and K. F. Young 31 Oct. 1973 24 p refs
(Contract N00014-63-C-0289; ARPA Order 2327)
(AD-768321; QTR-2) Avail: NTIS CSCL 20/5

Grating couplers have been fabricated in thin-film PbTe waveguides on BaF2 substrates. The grating spacings are between 1.8 and 2.1 micrometers, which is the appropriate range for coupling into the low order modes of a high index film (n 5-6) with a 10.6 micrometer CO2 laser. The gratings are first formed in a photoresist layer on the film using holographic or mask exposure. The pattern is then transferred to the PbTe by etching in a dilute bromic acid and bromine solution. The last step is essential for obtaining high coupling efficiencies. Due to the high index of the film, efficient coupling cannot be achieved with a low index photoresist layer alone. Coupling efficiencies are estimated to be approximately 10%. Tuning characteristics of a number of PbTe thin-film lasers are measured. Tuning rates are typically 1.5-0.15 GHz/mA depending on diode resistance and thermal impedance. The maximum tuning range observed in a single mode was 70 GHz. Author (GRA)

N74-14179# National Bureau of Standards, Washington, D.C.
LASER DAMAGE IN MATERIALS Semiannual Technical Report, 1 Feb. - 31 Jul. 1973
Albert Feldman, Deane Horowitz, and Roy M. Waxler Aug. 1973 45 p refs
(ARPA Order 2016)
(AD-768303; NBSIR-73-268) Avail: NTIS CSCL 20/5

Neodymium:glass laser induced damage is observed in lithium niobate ($LiNbO_3$), calcite ($CaCO_3$), potassium dihydrogen phosphate (KDP), and deuterated potassium dihydrogen phosphate (KD^*P). The damage at the lowest power levels is caused by inclusions. At higher power levels, filamentary damage, which is indicative of self-focusing, is observed in $LiNbO_3$. An analysis of self-focusing data in yttrium aluminum garnet shows that the Kerr effect is the dominant self-focusing mechanism, with some contribution from the thermal effect. Bulk and surface damage thresholds in neodymium-doped thoria; yttrium oxide ceramic are obtained relative to bulk damage thresholds in several optical materials. For solid materials relationships are obtained between the stress-optic coefficients and the electrostrictive coefficients under different geometric boundary conditions. Author (GRA)

N74-14180# Naval Research Lab., Washington, D.C.
ARPA-NRL LASER PROGRAM Semiannual Technical Report, 1 Jul. - 31 Dec. 1972
Jun. 1973 69 p refs
(ARPA Order 2062; NRL Proj. K03-08A; NRL Proj. N01-21)
(AD-767921; NRL-MR-2634) Avail: NTIS CSCL 20/5

The ARPA-NRL high energy laser program is concerned with the development of laser technology in four program areas; Chemical Lasers, Electric Discharge Lasers; High Power Glass Laser Techniques. The Chemical Laser Program has consisted of primarily two experiments; the development of a DF-CO2 supersonic transfer laser, and the study of the CO vibrational distribution from the reaction O - CS. Assembly of the amplifier chain of the short pulse CO2 laser system has continued. Under the New Laser Techniques Program a pulsed OD-CO2 transfer laser has been operated for the first time. The High Power Glass Laser is operating reliably and over 2000 shots have been fired during the last reporting period. This has permitted statistics to be compiled on the laser's performance and initial laser-target

interaction experiments to be carried out. (Modified author abstract) GRA

N74-14181# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
EXPERIMENTAL TECHNIQUES IN HOLOGRAPHIC INTERFEROMETRY M.S. Thesis
Richard Allan Everett Jun. 1973 93 p refs
(AD-767672) Avail: NTIS CSCL 20/4

Fiber light guides are used in conjunction with holographic interferometry. A Michelson interferometer was constructed to test for temporal coherence of light passing through fiber optics. A finite-fringe hologram of a no-flow condition was taken to prove the feasibility of applying fiber optics to this field of flow investigation. The effect of opaque bodies on interferometric data inversion was sought. Two schemes for replacing the missing fringe data were used to see if the accuracy of the calculated density fields could be enhanced. Author (GRA)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N74-14182 Carnegie-Mellon Univ., Pittsburgh, Pa.
AN INVESTIGATION OF THE PLASTIC FRACTURE OF HIGH-STRENGTH STEELS Ph.D. Thesis
Thomas Blaine Cox 1973 213 p
Avail: Univ. Microfilms Order No. 73-22864

Extensive metallographic examination of the longitudinal midplanes of strained and sectioned tensile specimens has been used in conjunction with fractography using tensile and fracture toughness specimens to study the plastic fracture processes at room temperature in high-purity and commercially prepared 18 Ni, 200 grade maraging steel and AISI 4340 steel. The reduction of impurity levels realized by special melting techniques results in substantial improvement in the values of fracture toughness due to the general reduction in sizes of the non-metallic inclusions. Using both notched and smooth round tensile specimens, the effects of stress triaxiality on plastic fracture have been studied. It is observed that the level of tensile stress triaxiality does not affect the void nucleation process in these alloys. However, increased levels of triaxial tension do result in greatly increased rates of void growth and a concomitant reduction in the resistance to plastic fracture. Dissert. Abstr.

N74-14183 Oklahoma Univ., Norman.
THERMOELECTRIC POWER OF VACANCIES IN ALUMINUM Ph.D. Thesis
Theodore Wesley Rybka 1973 142 p
Avail: Univ. Microfilms Order No. 73-23961

The thermoelectric voltage difference between a well-annealed aluminum wire and a quenched aluminum wire has been measured as a function of temperature from 4 K to 150 K. Measurements were made for several quench temperatures and two different quench media. These data were used to determine the effect of vacancies on the thermopower of aluminum. The thermopower is enhanced by vacancies at temperatures below about 70 K and reduced at higher temperatures. It is proposed that the enhancement is due to the change in electron-diffusion thermopower. A calculation of this effect has been made based on the theory of Nielsen and Taylor, and the agreement with experimental results is striking. The reduction in thermopower above 70 K is explained by the change in the phonon drag thermopower due to vacancies. The Rayleigh scattering parameter was determined from the experimental data and is compared to calculated values using the theories of Klemens and Carruthers. Dissert. Abstr.

N74-14184 Texas Technological Univ., Lubbock.
SOFT X-RAY SPECTRA OF ALUMINUM IN ALUMINUM-NICKEL ALLOYS Ph.D. Thesis
Franklin Gregory Potter 1973 72 p
Avail: Univ. Microfilms Order No. 73-23771

In a high resolution X-ray spectrometer capable of resolving emission lines at large Bragg angles, the energy shifts from a series of Al-Ni alloys were measured. The samples included $NiAl_3$, NiAl, Ni-20 at% Al, Ni-10 at% Al, Ni-4 at% Al and Il_2O_3. The energy shifts of the three lines for all of the samples were toward higher energy because the Ni atoms had removed electrons from the Al atoms. The change in the charge screening produced by the electron removal indicated that covalent and/or partially ionic bonds had formed in the Al-Ni directions. The number of Ni atoms in the Al atom's first coordinate sphere and of the Al-Ni bond strengths permitted a qualitative explanation of the melting points for these alloys. In particular, the melting point for NiAl, being higher than the melting point of either constituent, was explained. Dissert. Abstr.

N74-14185# Houston Univ., Tex.
EFFECTS OF DILUTE ALLOYING ON THE ELASTIC CONSTANTS AND SUPERCONDUCTING ENERGY GAP IN THALLIUM Ph.D. Thesis
Ronald Milton Crews 1973 121 p
Avail: Univ. Microfilms Order No. 73-22898

Velocity of sound and ultrasonic attenuation measurements have been made on two pure and two doped samples of thallium. One of the pure samples was grown from the melt and the other by strain-anneal and called the unmelted sample. All samples were single crystals and all measurements were made using 15 MHz longitudinal sound pulses. The elastic constants appropriate for a longitudinal wave travelling in the c axis direction have been measured as a function of temperature and impurity. The elastic constants were calculated from velocity of sound data. A sample band structure model based on the two plane wave approximation is presented and the band structure elastic constants calculated. The model gives relative changes in the elastic constants as a function of temperature and/or impurity. A term representing the electrostatic energy of the crystal is subtracted from the measured elastic constants and the result is compared to values predicted by the model. Dissert. Abstr.

N74-14186# Joint Publications Research Service, Arlington, Va.
FERROUS METALLURGY IN THE NINTH FIVE-YEAR PLAN
I. P. Kazanets 7 Dec. 1973 108 p refs Transl. into ENGLISH of the book "Chernaya Metallurgiya v Devyatoy Pyatiletke" Moscow, Met., 1972 110 p
(JPRS-60725) Avail: NTIS HC $7.50

A review of developments in ferrous metallurgy in the Ninth Five-Year Plan is presented. Special attention is devoted to problems of scientific and technical progress in the branch of industry, to a rise in the efficiency of production of ferrous metals, and also to the improvement in the economic indices of the work of the metallurgical industry in the Ninth Five-Year Plan. Author

N74-14187*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BEHAVIOR OF HYDROGEN IN ALPHA-IRON AT LOWER TEMPERATURES
Victor G. Weizer Washington Dec. 1973 29 p refs
(NASA-TN-D-7514; E-7496) Avail: NTIS HC $3.00 CSCL 11F

Evidence is presented that the low temperature anomalies in the hydrogen occlusive behavior of alpha iron can be explained by means of a molecular occlusion theory. This theory proposes that the stable state of the absorbed hydrogen changes from atomic at high temperatures to molecular as the temperature is lowered below a critical value. Theories proposing to explain the anomalous behavior as being due to the capture, at lower temperatures, of hydrogen in traps are shown to be unacceptable. Author

N74-14188*# United Aircraft Corp., East Hartford, Conn. Research Labs.
EUTECTIC SUPERALLOYS STRENGTHENED BY SIGMA, Ni_3Cb LAMELLAE AND GAMMA PRIME, Ni_3Al PRECIPITATES
F. D. Lemkey Washington NASA Nov. 1973 137 p refs

(Contract NAS3-15562)
(NASA-CR-2278; M911213-5) Avail: NTIS HC $4.50 CSCL 11D

By means of a screening and solidification optimization study of certain alloys located on the gamma-sigma liquidus surface within the Ni-Cb-Cr-Al system, alloys with high temperature properties superior to those of all known superalloys were defined. One alloy, Ni - 19.7w/o Cb - 6.0w/o Cr - 2.5w/o Al, directionally solidified at 3 cm/hr met or exceeded each program goal. A second alloy, Ni-21.75 w/o Cb-2.55 w/o Al, although deficient in its inherent oxidation resistance, met the other program goals and combined a remarkable insensitivity of composite microstructure to solidification parameters with excellent low temperature toughness. This investigation demonstrated that useful properties for gas turbine airfoil application have been achieved by reinforcing a strong and tough gamma solid solution matrix containing precipitated gamma prime by a lamellar intermetallic compound Ni3 Cb having greater strength at elevated temperature. Author

N74-14189*# Battelle Columbus Labs., Ohio.
DEVELOPMENT OF HIGH-EMITTANCE SCALES ON THORIATED NICKEL-CHROMIUM-ALUMINUM-BASE ALLOYS Contractors Report, 1 Jul. 1972 - 31 Aug. 1973
M. S. Seltzer, I. G. Wright, and B. A. Wilcox 15 Oct. 1973 70 p refs
(Contract NAS3-15845)
(NASA-CR-134514) Avail: NTIS HC $5.50, CSCL 11F

The surface regions of a DSNiCrAl alloy have been doped, by a pack diffusion process, with small amounts of Mn, Fe, or Co, and the effect of these dopants on the total normal emissivity of the scales produced by subsequent high temperature oxidation has been measured. While all three elements lead to a modest increase in emissivity, (up to 23% greater than the undoped alloy) only the change caused by manganese is thermally stable. However, this increased emissivity is within 85 percent of that of TDNiCr oxidized to form a chromia scale. The maganese-doped alloy is some 50 percent weaker than undoped DSNiCrAl after the doping treatment, and approximately 30 percent weaker after oxidation. Author

N74-14190*# Mar-Test, Inc., Cincinnati, Ohio.
HIGH TEMPERATURE, LOW-CYCLE FATIGUE OF COPPER-BASE ALLOYS IN ARGON. PART 1: PRELIMINARY RESULTS FOR 12 ALLOYS AT 1000 F (538 C)
J. B. Conway, R. H. Stentz, and J. T. Berling Jan. 1973 52 p
(Contract NAS3-16753)
(NASA-CR-121259) Avail: NTIS HC $4.75 CSCL 11F

Short-term tensile evaluations at room temperature and 538 C and low-cycle fatigue evaluations at 538 C are presented for the following materials: Zirconium copper-annealed, Zirconium copper-1/4 hard, Zirconium copper-1/2 hard, Tellurium copper-1/2 hard, Chromium copper-SA and aged, OFHC copper-hard, OFHC copper-1/4 hard, OFHC copper-annealed, Silver-as drawn, Zr-Cr-Mg copper-SA, CW and aged, Electroformed copper-30-35 ksi, and Co-Be-Zr- copper-SA, aged. A total of 50 tensile tests and 76 low-cycle fatigue tests were performed using a strain rate of 0.2 percent per second. Author

N74-14191*# McDonnell-Douglas Corp., St. Louis, Mo. Flight Sciences Dept.
CYCLICAL TESTS OF SELECTED SPACE SHUTTLE TPS METALLIC MATERIALS IN A PLASMA ARC TUNNEL VOLUME 1: DESCRIPTION OF TESTS AND PROGRAM SUMMARY Final Report
W. A. Rinehart, D. W. Land, J. H. Painter, and R. A. Williamson Jun. 1972 53 p refs 2 Vol.
(Contract NAS2-6601)
(NASA-CR-114459; MDC-Q0473-Vol-1) Avail: NTIS HC $4.75 CSCL 11F

Work, concerned with cyclical thermal evaluation of selected space shuttle thermal protection system (TPS) metallic materials in a hypervelocity oxidizing atmosphere that approximated an actual entry environment, is presented. A total of 325 sample test hours were conducted on 21 super-alloy metallic samples at temperatures from 1800 to 2200 F (1256 to 1478 K) without any failures. The 4 x 4 in. (10.2 x 10.2 cm) samples were fabricated from five nickel base alloys and one cobalt base alloy. Eighteen of the samples were cycled 100 times each and the other three samples 50 times each in a test stream emanating from an 8 in. (20.3 cm) diam exit, Mach 4.6, conical nozzle. The test cycle consisted of a 10 min heat pulse to a controlled temperature followed by a 10 min cooldown period. The TD-NiCrAl and TD-NiAlY materials showed the least change in weight, thickness, and physical appearance even though they were subjected to the highest temperature environment. Author

N74-14192*# McDonnell-Douglas Corp., St. Louis, Mo. Flight Sciences Dept.
CYCLICAL TESTS OF SELECTED SPACE SHUTTLE TPS METALLIC MATERIALS IN A PLASMA ARC TUNNEL. VOLUME 2: APPENDICES - DATA TABULATION Final Report
W. A. Rinehart, D. W. Land, J. H. Painter, and R. A. Williamson Jun. 1972 100 p ref 2 Vol.
(Contract NAS2-6601)
(NASA-CR-114520; MDC-Q0473-Vol-2) Avail: NTIS HC $7.00 CSCL 11F

Calibration data are presented for heat flux and pressure profiles, model temperature histories, and model weight and thickness changes. Author

N74-14193# Oak Ridge National Lab., Tenn.
EFFECT OF HYDROSTATIC STRESS ON CREEP AND CREEP RUPTURE OF POLYCRYSTALLINE METALS AT ELEVATED TEMPERATURES
Masateru Ohnami and Tetsuro Yamakage [1973] 15 p refs Transl. into ENGLISH from Zairyo (Japan), v. 21, no. 222, 1972 p 225-231 Presented at 20th Symp. of the Materials Sci. Soc., 22 May 1971 Sponsored by AEC
(ORNL-tr-2685) Avail: NTIS HC $3.00

Results of studies on the effects of hydrostatic pressure on high temperature tensile creep and creep-rupture life of pure polycrystalline Al are reported. Information and discussions are also included on effects of hydrostatic pressure on creep rate, effects of hydrostatic stress on creep rupture life, and experimental results. Author (NSA)

N74-14194# Oak Ridge National Lab., Tenn.
MECHANICAL BEHAVIOR OF AUSTENITIC STAINLESS STEELS
M. Tricot [1973] 18 p Transl. into ENGLISH from Met. Constr. Mac. (France), v. 104, no. 4, 1972 p 129-136 Sponsored by AEC
(ORNL-tr-2689) Avail: NTIS HC $3.00

The unusual mechanical behavior of austenitic steels in alloys is studied from the technical and economic viewpoint. Austenitic stainless steels have a superior capability to adapt to applied forces than do ordinary steels. The effects of speed of traction, heat treatment and weak hardening of various origins are discussed for the austenitic steel. An experiment on the influence of prestressing on the mechanical behavior of quenched austenitic stainless steel was performed. The peculiarities of creep of austenitic steels and the influence of composition and heat treatment on creep are discussed. A plastic deformation caused by a prior stress or caused by a previous creep under a large loading will considerably reduce the amount of creep during a later test. NSA

N74-14195# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
GRAIN REFINEMENT TRAIL IN CAST BERYLLIUM BY MOLD OSCILLATION
D. L. Fergason and C. R. Heiple 6 Aug. 1973 6 p refs
(Contract AT(29-1)-1106)
(RFP-1840) Avail: NTIS HC $4.00

Unsuccessful efforts to modify the grain size of cast beryllium by mold oscillation during solidification are described. No change in grain size or growth pattern could be induced within the range of oscillation frequency (up to 72 reversals per minute) and amplitude (up to about 75 deg between reversals) possible with the apparatus. Author (NSA)

N74-14196# Oak Ridge National Lab., Tenn.
MECHANICAL PROPERTIES AND INTERSTITIAL CONTAMINATION IN A MOLYBDENUM-BASE ALLOY, TZM
C. T. Lim and H. Inouye Aug. 1973 26 p refs

(Contract W-7405-eng-26)
(ORNL-TM-4238) Avail: NTIS HC $3.50

The deformation and fracture behavior of TZM (Mo-0.5% Ti-0.08% Zr-0.03% C) were studied after exposures at 825 and 1000 C to low-pressure O2, CO, H2O, and a simulated radioisotope thermoelectric generator environment. TZM showed an uptake of oxygen on exposure to these environments. Analysis of the results indicates that a diffusion process controls the kinetics of the oxygen absorption at 825 C while both diffusion and chemisorption processes affect the rate at 1000 C. Exposed TZM also exhibited a small initial increase in carbon content followed by a decrease. Decarburization became significant only after extended exposure at 1000 C. The ductility of embrittlement TZM was increased significantly with heat treatment at high temperatures and was almost completely restored after annealing for 15 min at 1700 C. The change in mechanical properties is discussed in terms of internal oxidation and precipitation of various forms of oxides. Author (NSA)

N74-14197# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EFFECTS OF IMPURITY LEVEL ON ELECTRON RADIATION DAMAGE IN ALUMINUM AT ELEVATED TEMPERATURES
J. O. Stiegler and K. Farrell [1973] 12 p refs Sponsored by AEC
(Conf-730831-1) Avail: NTIS HC $3.00

An increase in the general level of impurities affects the formation of loops and the evolution of dislocation structure in Al and Ni during bombardment with 650-kV electrons at elevated temperatures in a HVEM. In Al at 220 C, decreasing purity increases the concentration of loops, reduces their growth rates, increases the time to reach a steady state dislocation structure, and reduces the cutoff temperatures for loop formation, indicating that impurities enhance the nucleation of loops and suppress their growth. Annealing and re-irradiation experiments just below the cutoff temperature suggest that some loops may be reinitiated at their original sites implying nucleation at impurities or submicroscopic defects. The development of large, multiply faulted loops occurs in the higher-purity materials in the near surface regions after prolonged irradiation and considerable dislocation movement. Author (NSA)

N74-14198# Cornell Univ., Ithaca, N.Y. Materials Science Center.
FIELD-ION-MICROSCOPY STUDY OF THE POINT-DEFECT STRUCTURE OF A DEPLETED ZONE IN ION (W PLUS)-IRRADIATED TUNGSTEN
K. L. Wilson and D. N. Seidman 12 Jun. 1973 25 p refs Presented at Conf. on Defects and Defect Clusters in bcc Metals and their Alloys, Gaithersburg, Md., 14 Aug. 1973 Sponsored in part by NSF
(Contract AT(11-1)-3158)
(COO-3158-20; Conf-730813-9; Rept-2027) Avail: NTIS HC $3.25

The irradiated specimen was examined at 25 K by the pulse-field evaporation technique and a total of 2,000 frames of 35-mm cine were recorded and analyzed in the reconstruction of this depleted zone. The depleted zone was found to consist of 41 vacant lattice sites clustered in a cubic region of approximately 13 A on a side. No contrast effects that could be attributed to self-interstitial atoms were found in or near the depleted zone or in the lattice surrounding it. If only first-nearest-neighbor vacant lattice sites are considered, then the distribution of cluster sizes is as follows: (1) three mono-vacancies; (2) one divacancy (3) one trivacancy; (4) one sixvacancy cluster; and (5) one huge cluster of 27 vacancies. It was shown that this depleted zone was created by a single incident ion, and a comparison of the measured number of vacant lattice sites with the value predicted by the Kinchin-Pease model showed directly that this model overestimates the number of displacements created per incident ion by a factor of approximately five in this case (irradiation temperature of 473 K). Author (NSA)

N74-14199# California Univ., Berkeley. Lawrence Berkeley Lab.
STRUCTURE AND PROPERTIES OF Fe-Mo-C STEELS M.S. Thesis
Robert Allan Clark Jun 1973 64 p refs
(Contract W-7405-eng-48)
(LBL-1801) Avail: NTIS HC $5.25

The microstructures of a series of vacuum melted Fe-Mo-C and Fe-Mo-Co-C steels were investigated using transmission electron microscopy. The correlating mechanical properties of these steels were examined by fracture toughness tests, Charpy V-notch impact tests, tensile tests, and hardness measurements. Examinations of each alloy were conducted in the asquenced fully martensitic condition as well as martensites quenched and tempered for one hour at 400 and 600 C. Addition of Co to Fe-Mo-C steels inhibited or eliminated the secondary hardening effect normally observed. Toughness however, did not improve and in fact decreased with Co additions. It is concluded that Co additions are detrimental to Fe-Mo-C steels. Based on microstructural examinations, a hypothesis as to why Co has this affect is presented. An optimum Mo content for 0.4% carbon Fe-Mo-C steels is determined from the mechanical testing data and explained by the correlating microstructural features.
Author (NSA)

N74-14200# Sandia Labs., Livermore, Calif. Metallurgy Div.
HIGH ENERGY RATE FORMING STUDIES OF TWO EXPERIMENTAL A286-TYPE STAINLESS STEEL ALLOYS
P. B. Lindsay Jul. 1973 26 p refs
(Contract AT(29-1)-789)
(SLL-73-20) Avail: NTIS HC $3.50

The strengthening response of two experimental A286 type alloys to a high energy rate forming (HERF) process was investigated and compared to similar studies conducted on the conventional A286 material. The combination of HERF forging and aging of the experimental alloys produced only a slight strength increase with a significant loss in ductility.

N74-14201# Brown Univ., Providence, R.I. Div. of Engineering.
COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE FRACTURE OF METALS Technical Progress Report, Jul. 1972 - Jun. 1973
L. B. Freund, J. Gurland, and J. R. Rice Jul. 1973 14 p refs
(Contract AT(11-1)-3084)
(COO-3084-25) Avail: NTIS HC $3.00

New insight has been obtained on the problem of cleavage initiation in mild steel by coupling the critical stress-fracture criterion with a finite microstructurally significant size scale. Work has continued on interpreting macroscopic crack toughness parameters in terms of microstructural separation mechanisms, both theoretically and experimentally. A potentially very useful classification of crystals as brittle or ductile is proposed on the basis of the sign of the energy barrier for the emission of dislocations from the tip of a loaded crack. A project on diffusive mechanisms of crack growth and cavity growth at elevated temperature has been started with the aim of contributing to the theory of diffusional creep rupture. Studies continue on the modeling of ductile rupture processes involving the large plastic growth and coalescence of cavities. In particular, a finite element computational program for problems of large plastic deformation and instability has been developed and is being applied to some test cases. Author (NSA)

N74-14202# Sandia Labs., Livermore, Calif.
DEVELOPMENT OF MODIFIED A286 AUSTENITIC STAINLESS STEEL
P. B. Lindsay Aug. 1973 43 p refs
(Contract AT(29-1)-789)
(SLL-73-24) Avail: NTIS HC $4.25

Modifications were made to the chemistry and processing of A286 austenitic stainless steel in order to develop two experimental alloys, which were then analyzed for weldability, mechanical properties at room temperature, and compatibility with hydrogen. The two alloys showed higher yield strength and improved weldability over A286. Charging with hydrogen caused a 20% loss in reduction in area for Alloys A and B, while A286 showed only a 7% loss. All three alloys showed ductile-type failures in the charged and uncharged samples. Author (NSA)

N74-14203# Oak Ridge Y-12 Plant, Tenn.
METHOD FOR MEASURING THE HYDROGEN CONTENT OF METALS

G. L. Powell 27 Jul. 1973 14 p refs Presented at the Intern. Conf. on Hydrogen Embrittlement Effect on Metal Properties Selection and Design, Champion, Penna., 25 Sep. 1973
(Contract W-7405-eng-26)
(Y-DA-5219; Conf-730922-1) Avail: NTIS HC $3.00

The hydrogen content of uranium alloys in the order of one weight part per million (wppM) was determined using a previously reported instrument. The instrument was designed to (1) measure, mass-spectrographically, the instantaneous rate at which hydrogen is thermally evolved from a metal sample, thus allowing the time resolution of hydrogen produced by the decomposition of surface contaminants from the hydrogen evolved from the sample bulk; (2) compute, as a function of time, the quantity of hydrogen evolved from a metal sample in the range of 0.001 wppM to 100 wppM using one-gram samples; (3) operate under routine laboratory conditions with a sampling rate of approximately 40 samples per day. Uranium samples that were being Ni-plated were analyzed for hydrogen at various stages of the process. It was found that most of the hydrogen evolves within the first 20 seconds of the analysis. Hydrogen solubility in U-0.79% Ti alloy was studied; the relationship between hydrogen content and tensile properties of uranium alloys was also studied. NSA

N74-14204# Clarkson Coll. of Technology, Potsdam, N.Y.
TRANSPORT AND MAGNETIC PHENOMENA IN CHROMIUM AND IRON ALLOYS (4) Final Report, 4 Mar. 1969 - 30 Jun. 1973
S. Arajs 30 Jun. 1973 13 p refs
(Contract AT(11-1)-3259)
(COO-3259-29) Avail: NTIS HC $3.00

The electrical resistivity, thermoelectric power, thermal conductivity, and magnetization of different binary chromium and iron alloys over large temperature ranges (4 to 1700 k) were investigated from the viewpoint of their electronic structures and the interactions among elementary excitations in magnetically ordered metallic systems. Although iron and chromium base alloys are technologically important materials, their physical nature is only partially understood. The investigation was directed towards a better understanding of these important metallic systems from a fundamental point of view. Author (NSA)

N74-14205# California Univ., Berkeley. Lawrence Berkeley Lab.
VISCOSITY OF CESIUM METAL TO ITS CRITICAL TEMPERATURE
H. C. Tsai Jul. 1973 68 p refs
(Contract W-7405-eng-48)
(LBL-1413) Avail: NTIS HC $5.50

Cesium metal viscosity was measured up to 1600 C by oscillating-cup techniques. Viscous drag due to the saturated vapor phase was taken into account in the data analysis. Equations are given to represent the measured results. The critical viscosity of cesium determined from the law of rectilinear diameters is 0.57 + or- .04 millipoise. Viscosities of sodium and potassium were also estimated from the cesium data by the law of corresponding states. Author (NSA)

N74-14206# California Univ., Berkeley. Lawrence Berkeley Lab.
IRON-NICKEL-TITANIUM ALLOY WITH OUTSTANDING TOUGHNESS AT CRYOGENIC TEMPERATURE
S. Jin, J. W. Morris, Jr., and V. F. Zackay Jul. 1973 18 p refs Presented at Cryogenic Eng. Conf., Atlanta, 8-10 Aug. 1973
(Contract W-7405-eng-48)
(LBL-1484-Rev; Cong-730805-7) Avail: NTIS HC $3.00

Recent research has shown that the alloy Fe-12Ni-0.25Ti may be processed to have an outstanding combination of strength and toughness at cryogenic temperatures. Test results obtained to date with this alloy are presented and compared with data on the properties of two commonly used cryogenic steels. Tensile properties, impact properties, and preliminary results of fracture toughness tests are presented. Author (NSA)

N74-14207# California Univ., Berkeley. Lawrence Berkeley Lab.
DEVELOPMENT OF ECONOMICAL, TOUGH, ULTRAHIGH STRENGTH Fe-Cr-C STEELS
J. A. McMahon and G. Thomas Apr. 1973 10 p refs Presented at 3d Intern. Conf. on the Strength of Metals and Alloys, Cambridge, England, 20-25 Aug. 1973
(Contract W-7405-eng-48)
(LBL-1490; Conf-730806-2) Avail: NTIS HC $3.00

The structure and mechanical properties of Fe-Cr-C martensitic steels are examined with the aim of designing low-cost, strong, tough steels through control of microstructure. Chromium is not an effective solid-solution strengthener in ferritic alloy steels, and, because of this, substructural changes due to alloy additions such as C can be more readily correlated with changes in mechanical properties. Furthermore, Cr is relatively inexpensive yet a desirable alloying element, e.g., for hardenability. Author (NSA)

N74-14208# California Univ., Berkeley. Lawrence Berkeley Lab.
STRESS-INDUCED MARTENSITE-AUSTENITE INTERFACE IN Fe-15Ni-15Cr SINGLE CRYSTALS
G. A. Stone and G. Thomas Mar. 1973 5 p Presented at EMSA Meeting, New Orleans, 14-17 Aug. 1973
(Contract W-7405-eng-48)
(LBL-1499; Conf-730816-2) Avail: NTIS HC $3.00

A single crystal stressed in the /(-2)(-1)3/gamma direction at 185 K was transformed to 5% alpha martensite and 2% epsilon martensite by volume. The austenite slip system of maximum shear stress is the ((-1)11)gamma /01(-1)/gamma. A two-surface study using the electron and optical microscopes is shown. Measurements of the acicular crystal axis were made from optical micrographs using the trace of an epsilon plate on the plane cutting the (-1)11)gamma direction as a crystallographic reference. The physical nature of the interface is being revealed with (01(-1)gamma foils. Efforts to image interface dislocations have been unsuccessful to date. It appears clear that the interface between the phases in this alloy is a composite of dislocated austenite and faulted austenite giving rise to hcp reflections. Also the (110)alpha surface of the crystal is in contact with and parallel to the (0001)epsilon plane. The large very thin epsilon plates appear to control the size of the acicular alpha crystals and forces the long axis of the crystals to remain parallel to the austenite slip plane that is the (-1)11)gamma in this example. NSA

N74-14209# Brown Univ., Providence, R.I. Div. of Engineering.
RELATIONSHIP BETWEEN CRITICAL TENSILE STRESS AND FRACTURE TOUGHNESS IN MILD STEEL
R. O. Ritchie, J. F. Knott, and J. R. Rice Mar. 1973 29 p refs
(Contract AT(11-1)-3084)
(COO-3084-20) Avail: NTIS HC $3.50

An analysis is presented which relates the critical value of tensile stress for unstable cleavage fracture to the fracture toughness for a high nitrogen mild steel under plane strain conditions. Unstable fracture is found to be consistent with the attainment of a stress intensification close to the tip such that the maximum principal stress exceeds tensile stress over a characteristic distance, determined as twice the grain size. Results of the analysis are used to predict the experimentally determined variation of fracture toughness with temperature over the range - 150 to - 75 C from a knowledge of the yield stress and hardening properties. It is further shown that the onset of fibrous fracture ahead of the tip can be deduced from the position of the maximum achieved stress intensification. The relationship between the model for fracture ahead of a sharp crack, and that ahead of a rounded notch is discussed in detail. Author (NSA)

N74-14210# Oak Ridge National Lab., Tenn.
CARBIDE PRECIPITATION AND HIGH-TEMPERATURE STRENGTH OF 18-8 STAINLESS STEELS
R. Tanaka and T. Shinoda [1973] 14 p refs Transl. into ENGLISH from Zairyo (Japan), v. 21, 1972 p 198-203 Sponsored by AEC
(ORNL-tr-2686) Avail: NTIS HC $3.00

The relationship between the creep rupture strength and the dispersion state of precipitated carbides in 18-8 stainless steels is examined. Results of studies are reported in summary

manner to demonstrate the presence of an intimate relationship between these two items. It is noted that the addition of trace quantities of Ti and Nb is particularly effective in enhancing the fine and uniform precipitation of M23C6 and thereby improving the creep-rupture strength. It is also mentioned that the addition of trace quantities of Ti and Nb, along with the combination of N and B to 18-10 Mo steel, results in a rupture strength that is far-greater value than normally observed in this type of steel. Results of studies made on the factors responsible for the formation of fine carbide particles as a result of the addition of trace quantities of Ti and Nb show that the fine and uniform dispersed state of carbides and associated increase in high-temperature strength is not limited to the addition of Ti and Nb to austenite steel. Author (NSA)

N74-14211# Oak Ridge National Lab., Tenn.
CREEP RUPTURE STRENGTH AND STRUCTURE OF LOW-ALLOY STEELS
T. Yukitoshi and K. Nishida [1973] 14 p refs Transl. into ENGLISH from Zairyo (Japan), v. 21, 1972 p 204-211
(ORNL-tr-2688) Avail: NTIS HC Sponsored by AEC

The creep rupture strength and microstructure of chromium-molybdenum alloy steels were investigated. An inversion in the creep rupture strength due to the difference in prestructure was found in low chromium content steels. The analysis of extracted residues of the different steels indicate little change in the chromium content with annealing while there is a large change in the molybdenum content as a result of annealing. The precipitates in the ferrite or normalized-temper material as observed in the microstructure are finer than those in the annealed material. Author (NSA)

N74-14212# Oak Ridge National Lab., Tenn.
CREEP PROPERTIES OF Kh18N10T STAINLESS STEEL UNDER DIFFERENT TEMPERATURE CONDITIONS
A. M. Simonyan [1973] 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Ser. Mekh. (Erevan), v. 25, no. 2, 1972 p 75-82 Sponsored by AEC
(ORNL-tr-2702) Avail: NTIS HC $3.00

Creep of stainless steel under stresses of 1560 and 96 kg/sq cm at constant and variable temperatures ranging from 600 to 700 C was investigated. A generalized equation of creep at constant temperature for the case of variable temperature is derived from the theories of nonlinear heredity, hardening, and flow. The best agreement with experimental data under nonexothermal creep was provided by the theory of hardening in its general form. It was also shown that extinguishing part of the creep and instantaneous deformation are not reversible with temperature variation. Author (NSA)

N74-14213# Purdue Univ., Lafayette, Ind. School of Materials Engineering.
TRANSPORT AND THERMODYNAMIC PROPERTIES OF SOLIDS Progress Report, 1 Sep. 1972 - 31 Aug. 1973
R. E. Grace and M. A. Dayanada 1973 26 p
(Contract AT(11-1)-1436)
(COO-1436-38) Avail: NTIS HC $3.50

The principal area of research is ternary diffusion in solid-solution alloys. Data are given for diffusion in the Cu-Zn-Ni system. NSA

N74-14214# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
DEFORMATION PROCESSES IN REFRACTORY METALS Progress Report, 1 Dec. 1972 - 30 Nov. 1973
A. M. Garde, J. R. Donoso, and R. E. Reed-Hill 1973 24 p refs
(Contract AT(40-1)-3262)
(ORO-3262-31) Avail: NTIS HC $3.25

Current work is largely concerned with the mechanical behavior of niobium, as affected by dynamic strain aging. In addition, the relation between the dislocation structure and the anomalous work-hardening phenomena associated with dynamic strain aging is being investigated with the aid of transmission electron microscopy. For this investigation titanium is currently being used. This will be replaced by niobium in the near future. Author (NSA)

N74-14215# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF TEMPERATURE ON THE PLASTICITY OF TITANIUM
L. S. Moroz and S. S. Ushkov 18 Sep. 1973 13 p refs Transl. into ENGLISH from the publ. "Novyi Konstruktsionny Material-Titan" USSR, 1972 p 89-93
(AD-768056; FTD-HT-23-133-74) Avail: NTIS CSCL 11/6

The study of the temperature dependence of the plasticity of titanium and its alloys has attracted much attention. Nevertheless, dependence of relative elongation has not been explained. Relative elongation is widely used as a characteristic for evaluating quality of materials. Therefore investigating the effect of temperature on the amount of relative elongation and establishing the causes responsible for its temperature dependence are of considerable interest. Author (GRA)

N74-14216# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF ALLOYING COMPONENTS ON THE HYDROGEN ABSORPTION OF TITANIUM ALLOYS DURING ETCHING
V. Usova, V. N. Modestova, and N. D. Tomashov 28 Sep. 1973 11 p refs Transl. into ENGLISH from the publ. "Novyi Konstruktsionny Material-Titan" USSR, 1972 p 170-174
(AD-768058; FTD-HT-23-152-74) Avail: NTIS CSCL 11/6

The paper discusses etching titanium and alloys of the Ti-Al system in solutions containing hydrochloric and sulphuric acid and in solutions containing hydrofluoric acid. Hydrogen absorption is established with respect to time. The presence of aluminum in titanium reduced its hydrogen absorption. Alloys with additional elements were found to have less hydrogen absorption than have binary alloys. GRA

N74-14217# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE BEHAVIOR OF 3.8 PERCENT Al TITANIUM ALLOY DURING FRICTION
I. V. Ashikhmina and V. N. Goldfaiyn 4 Oct. 1973 12 p refs Transl. into ENGLISH from the publ. "Novyi Konstruktsionny Material Titan" USSR, 1972 p 120-124
(AD-768054; FTD-HT-23-141-74) Avail: NTIS CSCL 11/6

A study of the worn out parts of machines and mechanisms produces a general conclusion regarding the noticeable changes in the original structure and properties of the metal in direct proximity to the friction surface. This article is an attempt to describe the changes which unfold in the surface layers of titanium during friction and to compare these changes with a similar picture observed in other materials. GRA

N74-14218# Army Materials and Mechanics Research Center, Watertown, Mass.
MECHANICAL BEHAVIOR OF AN ULTRAFINE GRAIN FERRITIC STEEL
V. Ramachandran and Ernest P. Abrahamson, II Mar. 1973 21 p refs
(DA Proj. 1T0-62105-A-328)
(AD-768152; AMMRC-TR-73-14) Avail: NTIS CSCL 11/6

The mechanical properties of a ferritic steel with grain size ranging from 0.42 to 8 micrometers has been investigated. The material shows a marked increase in plastic instability. Decreasing the grain size is shown to decrease the temperature range for dynamic strain aging. Author (GRA)

N74-14219# Army Materials and Mechanics Research Center, Watertown, Mass.
OXIDATION OF COLUMBIUM AND COATED COLUMBIUM ALLOYS
Milton Levy, Joseph J. Falco, and Robert B. Herring Jul. 1973 30 p refs
(DA Proj. 1T1-62105-A-328)
(AD-768153; AMMRC-TR-73-35) Avail: NTIS CSCL 11/6

Oxidation of columbium alloys FS-85, SU-31, and a complex disilicide coating/SU-31 and FS-85 alloy systems has been studied in the temperature range 1400 to 2700 F at 1 atm and 50 Cm/sec flow rate of air. For studies of the uncoated alloys, the flow rate and pressure dependence of the alloys was also investigated. The experimental methods included thermogravimetric measurements of oxidation rates and studies on reacted specimens by

means of X-ray diffraction, metallographic techniques, and electron microprobe analysis. Two anomalies in the temperature dependence of the oxidation. rate were observed for both alloys and were related to the oxides formed. The SU-31 alloy has the best oxidation resistance. The oxidation mechanism of the alloys is discussed along with the mechanism of protection afforded by the complex disilicide coating system. The coating did not fail after 1000 hours of oxidation Author (GRA)

N74-14220# Army Materials and Mechanics Research Center, Watertown, Mass.

TENSILE BEHAVIOR OF A DILUTE ALPHA TITANIUM ALLOY OF ULTRAFINE GRAIN SIZE

V. Ramachandran and Ernest P. Abrahamson, II May 1973 14 p refs

(DA Proj. 1T0-62105-A-328)

(AD-768151; AMMRC-TR-73-24) Avail: NTIS CSCL 11/6

A solid solution alpha titanium alloy was studied at two grain sizes (1 and 6 micrometers). The room temperature strength of the finer grain size material is approximately 50% greater than the coarser material. Studies of dynamic strain aging and work hardening rate as a functon of grain size are reported. Author (GRA)

N74-14221# Stanford Research Inst., Menlo Park, Calif.

DEVELOPMENT OF ULTRAHIGH-STRENGTH, DUCTILE TITANIUM ALLOYS BY THERMOMECHANICAL PROCESSING AND TRANSFORMATION-INDUCED PLASTICITY Final Report, 1 Mar. 1972 - 31 May 1973

Robin L. Jones Jun. 1973 58 p refs

(Contract N00019-72-C-0201; SRI Proj. PYU-1774)

(AD-767780) Avail: NTIS CSCL 11/6

This report summarizes the results obtained during the third year of a program aimed at the development of high strength titanium alloys showing enhanced ductility and toughness due to the occurrence of deformation-induced phase transformation. Binary alloys of titanium with the beta-eutectoid solutes iron, manganese, and chromium were investigated during the first half of this program. The second half of the program was devoted to an investigation of the deformation-induced transformation behavior and mechanical properties of alloys based on Transage 129 (Ti-2Al-11V-2Sn-11Zr). Marked transformation-induced plasticity (TRIP) behavior was observed for the experimental alloys in a beta-annealed condition, especially when the V:Al content ratio was reduced below 5.5. When the alloys were aged to increase the yield strength the TRIP behavior disappeared, although deformation-induced transformation still occurred in some instances. The reasons for this behavior are discussed in the report and it is concluded that a high yield strength and TRIP behavior are mutually exclusive in these alloys, since both depend on the same strengthening mechanism. (Modified author abstract) GRA

N74-14222# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.

COMPARISON OF FIRST QUADRANT YIELD LOCI FOR TI-6AI-4V WITH THOSE PREDICTED BY KNOOP HARDNESS AND STRAIN RATIO MEASUREMENTS Report for Jul. 1972 - Jun. 1973

Maurice F. Amateau and William D. Hanna 15 Oct. 1973 22 p refs

(Contract F04701-73-C-0074)

(AD-768337; TR-0074(4250-10)-3; SAMSO-TR-73-305) Avail: NTIS CSCL 11/6

The first quadrant yield loci of the Ti-6AI-4V alloy determined by means of tensile tests in the rolling and transverse directions and compression tests in the thickness direction were compared with those predicted by Hill's theory of anisotropic yielding and Knoop hardness measurements. Sheet material in the hot-rolled, cold-rolled, and mill-annealed conditions possessing various degrees of anisotropy were examined. The loci predicted from the Knoop hardness measurements did not agree with the measured yield loci for any of the conditions examined. Those predicted by Hill's theory agreed with the measured loci for materials of R value greater than one. Author (GRA)

N74-14223# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CRITICAL SURVEY OF INVESTIGATIONS OF THE EQUILIBRIUM DIAGRAM OF THE Ti-W SYSTEM

I. I. Kornilov, T. T. Nartova, and S. V. Oleinikova 18 Sep. 1973 9 p refs Transl. into ENGLISH from the publ. "Novyi Konstruktsionny Material Titan" USSR, 1972 p 16-19

(AD-768046; FTD-HT-23-119-74) Avail: NTIS CSCL 11/6

The study results in a conclusion concerning the existence of a continuous solid solution between beta-titanium and tungsten at high temperatures. Divergence in the conclusions of different authors is explained by the insufficient homogeneity of the cast alloys and the effect of admixtures on the structure of these alloys. GRA

N74-14224# Army Material Command, Texarkana, Tex. International Training Center.

NONDESTRUCTIVE CRACK DETECTION OF FATIGUED 1040 STEEL USING ANALOG TO DIGITAL METHODS

Roger Mielec May 1973 66 p refs

(AD-768127; USAMC-ITC-1-73-11) Avail: NTIS CSCL 11/6

A study was made to investigate a method of nondestructive testing (NDT) as related to fatigue crack damage. Vibration techniques, a high speed fatigue testing machine, and a small digital computer were used to attain research objectives. The vibration analysis consisted of vibrating 1040 hot rolled steel fatigue specimens after periodically being dismounted from a fatigue testing machine. While being vibrated by mechanical means, the dynamic characteristics of the specimen with the fatigue cracks were recorded. Author (GRA)

N74-14225# British Steel Corp., London (England).

THE FORMABILITY OF PRECIPITATION HARDENED STEELS

N. A. Cantalejos and R. A. Maynard Aug. 1973 7 p refs

(PB-223686/7GA; BISRA-MT/4/73) Avail: NTIS HC $3.00 CSCL 11F

A study of the cold formability of high strength sheet steels having yield strengths of the order of 350 Newtons per square millimeter was made. The interest in forming these steels originates with the increasing usage of strong steels in thin sections in a wide range of pressing applications where the formed component is required to withstand severe service conditions. Typically, strengths up to 500 Newtons per square millimeter are being demanded, in contrast to the 160-240 Newtons per square millimeter found in the majority of steels currently sold for cold forming. The problem is that, generally, the higher the strength of the materials, the more difficult it is to form. Author (GRA)

N74-14226# British Steel Corp., London (England). Corporate Development Lab.

HIGH STRENGTH HEAVY GAUGE STRIP BY CONTROLLED COOLING

P. Mella and A. D. Higgins Jun. 1973 16 p refs

(PB-223709/7GA; BISRA-MT/7/73) Avail: NTIS CSCL 11F

It is shown that simple, inexpensive strip steels can be upgraded to higher strength levels by employing rapid cooling immediately after hot rolling. Two steels differing mainly in their manganese contents were studied to determine the influence of thickness and composition on the effectiveness of this treatment. It is confirmed that the property improvements achieved originate with the resulting microstructural refinement, strengths of up to 414 Newtons per square millimeter together with excellent ductility and impact properties having been attained in 6.3 mm thick strip. It is likely that a controllable water cooling system could be used to counteract the effect of thickness on strength. GRA

N74-14227# British Steel Corp., London (England). General Steels Div.

A COMPARISON OF LAPPING AND LINISHING AS SAMPLE PREPARATION TECHNIQUES FOR THE X-RAY FLUORESCENCE ANALYSIS OF LOW ALLOY STEELS

A. A. Tunney Aug. 1973 6 p

(PB-223577/8GA; BISRA-GS/EX/4/73/C) Avail: NTIS HC $3.00 CSCL 11F

A selection of low alloy steel standards has been repetitively analysed for Si, Mn, P, S, Cr, Ni, Mo, Nb, Sn, Ti, V and Zr on an X-ray fluorescence spectrometer using both lapping and linishing as surface preparation techniques. Overall 95% confidence

limits have been calculated for each surface treatment, and plots of coefficient of variation against concentration prepared for each element. The results indicate that the manual setting-up of the spectrometer is the dominant factor in determining the final precision achieved and that lapped samples give no improvement in precision compared with linished samples. The latter technique can therefore be used with confidence for the X-ray analysis of low alloy steel samples for production control where speed of analysis is critical. GRA

N74-14228# British Steel Corp., London (England). General Steels Div.
A PROGRAM TO PROCESS STEEL ANALYSIS DATA FROM AN A.R.L. 72000 X-RAY FLUORESCENCE SPECTROMETER
A. A. Tunney Aug. 1973 8 p
(PB-223730/3GA; BISRA-GS/EX/22/73/C) Avail: NTIS HC $2.75 CSCL 11F

A program to process the data obtained in the analysis of mild and low alloy steels by X-ray fluorescence is described. The program corrects for changes in calibration curves which occur due to instrumental drift and also corrects for features such as line overlap prior to conversion of intensities into percentages. The performance of the program in correcting for drift is illustrated and the long term precision obtained over a period of seven months is given in detail. The system described is easily adaptable to any direct reading instrument either for use with an off-line or small dedicated computer. GRA

N74-14229# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
CORROSION RESISTANCE OF METALS IN HOT BRINES: A LITERATURE REVIEW Information Circular, 1971 - 1972
Lloyd H. Banning and Laurance L. Oden Aug. 1973 45 p refs
(PB-223715/4GA; BM-IC-8601) Avail: NTIS; SOD HC $0.70 as Stock No. 2404-01435 CSCL 11F

Electrical energy generated from dry geothermal steam and steam flashed from hot pressurized geothermal water will increase in importance in the next few decades. Geothermal fluids, which contain appreciable quantities of dissolved salts and gases, are generally corrosive to materials of construction. Since data on corrosion of materials in geothermal brines is limited, the literature was surveyed through February 1972 to obtain a compilation of information on corrosion resistance of aluminum and its alloys, copper and copper-base alloys, carbon steel and vast iron, stainless steels, chromium-iron alloys, nickel- and cobalt-base alloys, and titanium in heated sea water as well as in geothermal brines. (Modified author abstract) GRA

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N74-14230*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SILICA REUSABLE SURFACE INSULATION Patent Application
Howard E. Goldstein, Marnell Smith, and Daniel Leiser, inventors (to NASA) Filed 26 Dec. 1973 13 p
(NASA-Case-ARC-10721-1; US-Patent-Appl-SN-427775) Avail: NTIS HC $3.00 CSCL 11D

A silica surface insulation material, ordinarily in the form of reusable tiles, is provided which is easy to manufacture and has efficient fire retardant and insulating properties. The method is shown wherein silica fibers are washed, blended with a colloidal silica permanent binder and a temporary binder and are then mixed and molded into a desired shape. The tiles are then dried and fired at an elevated temperature which burns out the temporary binder and leaves only the silica fibers bound with fused silica. Upon cooling, the tiles are machined to a desired size. NASA

N74-14231*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH GAS VELOCITY BURNER TESTS ON SILICON CARBIDE AND SILICON NITRIDE AT 1200 C
William A. Sanders and Hubert B. Probst 1973 49 p refs Presented at Army Materials Technol. Conf. on Ceramics for High Performance Appl., Hyannis, Mass., 13-16 Nov. 1973
(NASA-TM-X-71479; E-7798) Avail: NTIS HC $4.50 CSCL 11D

Specimens of silicon carbide and silicon nitride were exposed to a Mach one gas velocity burner simulating a turbine engine environment. Cyclic tests up to 100 hour duration were conducted at specimen temperatures of 1200 C. A specimen geometry was used that develops thermal stresses during thermal cycling in a manner similar to blades and vanes of a gas turbine engine. Materials were compared on a basis of weight change, dimensional reductions, metallography, fluorescent penetrant inspection, X-ray diffraction analyses, failure mode, and general appearance. One hot pressed SiC, one reaction sintered SiC, and three hot pressed Si3N4 specimens survived the program goal of 100 one-hour cycle exposures. Of the materials that failed to meet the program goal, thermal fatigue was identified as the exclusive failure mode. Author

N74-14232*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF ROLLING ON THE HIGH TEMPERATURE TENSILE AND STRESS-RUPTURE PROPERTIES OF TUNGSTEN FIBER-SUPERALLOY COMPOSITES
Donald W. Petrasek 1974 18 p refs Proposed for presentation at the 19th Natl. Symp. and Exhibition, Anaheim, Calif., 23-25 Apr. 1974; sponsored by the Soc. for Advan. of Mater. and Process Eng.
(NASA-TM-X-71484; E-7812) Avail: NTIS HC $3.00 CSCL 11D

An investigation was conducted to determine the effects of mechanical working on the 1093 C (2000 F) tensile and stress-rupture strength of tungsten alloy/superalloy composites. Hot pressed composites containing either conventional tungsten lamp filament wire or tungsten-1% ThO2 wire and a nickel base alloy matrix were hot rolled at 1093 C (2000 F). The hot pressed and rolled composite specimens were then tested in tension and stress-rupture at 1093 C (2000 F). Rolling decreased the degree of fiber-matrix reaction as a function of time of exposure at 1093 C (2000 F). The stress-rupture properties of the rolled composites were superior to hot pressed composites containing equivalent diameter fibers. Rolling did not appreciably affect the 1093 C (2000 F) ultimate tensile strength of the composites. Author

N74-14233*# Avco Corp., Lowell, Mass. Systems Div.
HIGH TEMPERATURE COMPOUNDS FOR TURBINE VANES
W. H. Rhodes and R. M. Cannon, Jr. Jan. 1974 74 p refs (Contract NAS3-16757)
(NASA-CR-134531; AVSD-0006-74-CR) Avail: NTIS HC $5.75 CSCL 11D

Fabrication and microstructure control studies were conducted on SiC, Si3N and composites based on Si3N. Charpy mode impact testing to 2400 F established that Si3N4/Mo composites have excellent potential. Attempts to fabricate composites of Si3N4 with superalloys, both by hot pressing and infiltration were largely unsuccessful in comparison to using Mo, Re, and Ta which are less reactive. Modest improvements in impact strength were realized for monolithic Si3N4; however, SiC strengths increased by a factor of six and now equal values achieved for Si3N4. Correlations of impact strength with material properties are discussed. Reduced MgO densification aid additions to Si3N4 were found to decrease densification kinetics, increase final porosity, decrease room temperature bend strength, increase high temperature bend strength, and decrease bend stress rupture properties. The decrease in bend strength at high temperature for fine grain size SiC suggested that a slightly larger grain size material with a nearly constant strength-temperature relation may prove desirable in the creep and stress rupture mode. Author

N74-14234*# TRW Systems Group, Redondo Beach, Calif.
CRYOGENIC/HIGH TEMPERATURE STRUCTURAL ADHESIVES Final Report
R. W. Vaughan and C. H. Sheppard Jan. 1974 77 p refs
(Contract NAS3-16780)
(NASA-CR-134465; TRW-22898-6012-TU-00) Avail: NTIS HC $6.00 CSCL 11A

Results are described of the work performed to develop a structural adhesive system which possesses useful properties over a 20K (-423 F) to 589 K (600 F) temperature range. Adhesives systems based on polyimide, polyphenylquinoxaline polyquinoxaline, polybenzothiazole and polybenzimidazole polymers first were screened for suitability. Detailed evaluation of two polyimide adhesive sytems, Br34/FM34 and P4/A5F or P4A/A5FA, and one polyphenylquinoxaline adhesive system, PPQ II (IMW), then was performed. Property information was generated over the full temperature range for shear strength, stressed and unstressed thermal aging, thermal shock and coefficient of thermal expansion. Both polyimide adhesive systems were identified as being capable of providing structural adhesive joints for cryogenic/high temperature service. Author

N74-14235# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Technische Physik.
ENERGY TRANSMISSION BY MEANS OF CRYOCABLES
H. Birnbreier, K. Duering, W. Fischer, I. Heller, A. Hofmann, P. Komarek, E. Kuhn, H. W. Luecking, W. Rasquin, and E. Zimmermann Mar. 1973 241 p refs In GERMAN; ENGLISH summary
(JUL-938-TP) Avail: AEC Depository Libraries HC $14.75

Six kinds of electrical insulations, three variations of the flow of the cooling medium, too possibilities for the arrangement of electrical and thermal insulation, and some kinds of conductor constructions are discussed. The justification of the use of a cryocable depends on the construction of the cable, on the materials that are used, and on the cooling machinery. For economic reasons, aluminum or copper will be the preferred material for the conductors. The cooling liquid can only be liquid nitrogen. The costs take into account the capital cost of the cable, termination and fitting costs, including installation, civil engineering, cooling stations, and costs of power losses, i.e., the costs for the electrical losses in the cable and the energy costs for the cooling stations. NSA

N74-14236# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).
HIGH-TEMPERATURE REACTION OF URANIUM CARBIDES AND TRANSIENT METAL CHLORIDES IN MOLTEN CHLORIDE MEDIA
M. Taube, J. Strejcek, and F. Dietler Jun. 1973 48 p refs
(EIR-238) Avail: AEC Depository Libraries HC $4.50

The reaction of UC with molten metal chlorides (AlCl3, ZnCl2,CdCl2, HgCl2, MnCl2) in molten alkali chlorides NNaCl, KCl, RbCl, CsCl and eutectics NaCl/KCl, NaCl/CaCl2) between 600 to 970 C in sealed silica ampules was investigated. The kinetics (half time of dissolution) and the equibrium were measured. In the system UC/MnCl-NaCl for the equilibrium state, the concentrations of uranium in both solid and liquid phases are roughly equal, permitting investigation of the influence of the secondary components (small amounts of uranium oxycarbide, uranium sequicarbide) and the impact of different alkali metal ions. The activity coefficient of uranium trichloride in these media was assessed. Author (NSA)

N74-14237# Sandia Labs., Albuquerque, N.Mex.
VARIABLE BIREFRINGENCE, LIGHT SCATTERING, AND SURFACE-DEFORMATION EFFECTS IN PLZT CERAMICS
C. E. Land 1973 32 p refs Presented at 3d Intern. Meeting on Ferroelec., Edinburgh, 10 Sep. 1973 Sponsored by AEC
(SLA-73-5441; Conf-730933-1) Avail: NTIS HC $3.75

A description is given of the several electrooptic effects of lead lanthanum zirconate titanate (PLZT) ceramics. Transverse and longitudinal electrooptic effects are covered. Work which leads to a better understanding of the effects is discussed. NSA

N74-14238# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
STUDY OF STRUCTURAL CRITERIA FOR COMPOSITE AIRFRAMES, VOLUME 1: EVALUATION Final Technical Report
Sherrill D. Manning and Glen H. Lemon Wright-Patterson AFB, Ohio AFFDL Apr. 1973 248 p refs 3 Vol.
(Contract F33615-72-C-1066)
(AD-767706; AFFDL-TR-73-4-Vol-1) Avail: NTIS CSCL 11/4

Criteria and design practices currently used for aircraft structures are examined and evaluated for applicability to composite structures. Selected probabilistic or statistical rationales are also reviewed and evaluated for possible applications. From these studies a plan was developed for acquiring understanding and data from which structural criteria and design practices applicable to composite airframes may be written. The basic characteristics of filamentary composites that are unique in comparison to those of metals are defined and explored. Special areas investigated include laminates, joints, and cutouts. (Modified author abstract) GRA

N74-14239# General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
STUDY OF STRUCTURAL CRITERIA FOR COMPOSITE AIRFRAMES. VOLUME 2: CURRENT/CRITERIA/SELECTED RATIONALE REVIEW AND EVALUATION Final Techinical Report
Sherrill D. Manning, Glen H. Lemon, and Innes Bouton Wright Patterson AFB, Ohio AFFDL Apr. 1973 227 p refs 3 Vol.
(Contract F33615-72-C-1066)
(AD-767707; AFFDL-TR-73-4-Vol-2) Avail: NTIS CSCL 11/4

Criteria and design practices currently used for aircraft structures are examined and evaluated for applicability to composite structures. Selected probabilistic or statistical rationales are also reviewed and evaluated for possible applications. From these studies a plan was developed for acquiring understanding and data from which structural criteria and design practices applicable to composite airframes may be written. The basic characteristics of filamentary composites that are unique in comparison to those of metals are defined and explored. Special areas investigated include laminates, joints, and cutouts. The structural criteria derived from metallic structure experiences are not applicable to composite structure because the critical interaction of a low strain to failure material with structural complexity is not recognized; universal requirements and rigid design practices irrespective of material, design concept or manufacturing methods, or size effects are imposed, and an assumption of translation of residual strength and lifetime allowables from the material level to the component level, which is incompatible with observed composite behavior is imposed. Accelerated test procedures have not been developed successfully; therefore, near-term composite designs should be developed using a realistic random load and environment simulation. In order to achieve the necessary confidence in structural integrity, the composite design should acknowledge fleet size, reliability goals, structural complexity, scaling from test specimen-to-component level. (Modified author abstract) GRA

N74-14240# Missouri Univ., Rolla. Dept. of Ceramic Engineering.
HIGH TEMPERATURE IR GLASSES Final Technical Report, 1 Sep. 1972 - 31 Aug. 1973
Norbert J. Kreidl 31 Aug. 1973 50 p refs
(Contract N00014-69-A-0141-0003)
(AD-767783; FTR-4) Avail: NTIS CSCL 11/2

Glasses in the system Si-As-Ag-Te-Se were found to have much higher softening temperatures than any chalcogenide glasses previously investigated. One heat treated glass had a softening temperature of 670C, which is 220 degrees higher than that of the Si-As-Se base glass. Ir transmission in relevant ranges was essentially maintained. Ag is instrumental in allowing the introduction of Se otherwise rejected in silicon chalcogenide glasses. The development of microstructure is more important than the intended increase in average bonding by the substitution of Se for Te. The microstructure involves glass-glass phase separation, with one of the phases having a much higher Tg, and, possibly, some microcrystallinity. (Modified author abstract) GRA

N74-14241# Solar, San Diego, Calif.
HOT CORROSION RESISTANT ALUMINIDE COATINGS OF

CONTROLLED COMPOSITION FOR NICKEL BASE SUPERALLOYS Final Report, 15 Jan. 1971 - 9 Jul. 1973
Victor S. Moore and A. R. Stetson Jul. 1973 220 p refs
(Contract N00156-71-C-1020)
(AD-767728; RDR-1702-3) Avail: NTIS CSCL 11/3

The objective of the program was to develop and evaluate new application techniques and aluminide coatings of controlled composition for improved hot corrosion resistance of nickel-base superalloys. Three cast nickel-base alloys were included in the coating development program: Inco 713C, B1900 and TRW (or NASA) VIA. Procedures and techniques were developed for applying modified elements of known composition onto nickel-base alloys followed by aluminizing to form the beta NiAl aluminide. The modifying elements evaluated were Cr, Co, Y, La, Nd, Gd, Mischmetal, Ti, Zr, Si, Al2O3, MgO, Mo, W, Ta, and several combinations of the above refractory, reactive, and rare earth metals. A crucible sulfidation test (using 95Na2SO4-5NaCl) at 1750F was the principal screening test used during coating development. Oxidation tests at 1750F and 2000F and ballistic impact tests (followed by crucible sulfidation tests) were also used to screen the coatings. Final evaluation of selected coatings consisted of hot corrosion rig tests at 1650F and 1800F, tensile tests at room temperature, 1400F and 1800F, stress rupture testing at 1650F and 1800F and low-cycle fatigue tests at 1400F. (Modified author abstract) GRA

N74-14242# General Electric Co., Philadelphia, Pa. Re-Entry and Environmental Systems Div.
ADVANCED HARDENED ANTENNA WINDOW MATERIALS STUDY, 3 Final Report, 19 May 1972 - 19 Apr. 1973
James P. Brazel Jul. 1973 255 p refs
(Grant DAAG46-72-C-0173; DA Proj. 1B0-62113-A-661)
(AD-768225; AMMRC-CTR-73-26) Avail: NTIS CSCL 11/4

The development and characterization of the ADL-10 composite hardened antenna window (fused silica Omniweave) reinforcement/SR-350 methyl silicone resin matrix was completed. A variety of methods for densification of silica Omniweaves to inorganic RF transmitting composites was studied and compared. These included multiple impregnations and pyrolyses with SR-350 (the Markite process), pyrolysis of a silane resin, densification with Ludox colloidal silica sols, chemical vapor deposition of silica and boron nitride, and a series of glass-bonded boron nitride matrices. Two of these approaches yielded promising composites: ADL-4D6, from the colloidal silica matrix in both a 4-D and 5-D reinforcement design; and BNQ, the glass-bonded boron nitride matrix composite with 4-D Omniweave. The report contains data on flexure and tensile strengths and elastic properties, flyer plate shock impact testing by both aluminum and mylar flyers, RF/dielectrics, ultrasonic and radiographic NDT, thermal conductivity and ablation testing. An analytic section compares the structural properties of 3-D, 4-D and 5-D composites of silica-silica and silica-silicone. (Modified author abstract) GRA

N74-14243# Artech Corp., Falls Church, Va.
EVALUATION OF MULTILAYER THIN FILMS Final Report, 9 May - 27 Aug. 1973
Fred Ordway and James R. Graves Sep. 1973 26 p refs
(Contract DAAK02-72-D-0223)
(AD-767724; J7114.10-FR) Avail: NTIS CSCL 11/4

Multilayer thin-film composites of carbon-aluminum were prepared by vacuum evaporation of alternating layers a few hundred Angstroms thick. Up to 94 pairs of successive layers were deposited to produce composite films up to 12.5 micrometers (0.0005 in.) thick. The specimens were evaporated through a photoetched metal mask to produce a dogbone shape for tensile testing, and were successfully removed without breakage by applying a thin release film of gold to the glass substrate before deposition of the composite and wetting the gold film with a small quantity of mercury afterward. A method is proposed by which the true tensile strength of the composite may be determined. (Modified author abstract) GRA

N74-14244# Army Coating and Chemical Lab., Aberdeen Proving Ground, Md.
AUTOMOTIVE ENGINE OIL SUPPLEMENTS: THEIR CHARACTERISTICS AND EFFECTIVENESS Final Report
Maurice E. Lepera Aug. 1973 32 p refs
(DA Proj. 1T6-62611-A-107)
(AD-767537; CCL-3003) Avail: NTIS CSCL 11/8

Crankcase oil additive concentrates, designed for use as an oil supplement oriented towards consumer or after market applications, were investigated in an attempt to define their overall performance effectiveness. Physiochemical data was generated on the eighteen oil concentrates to assist in understanding the mechanism of their reported activity. Their effectiveness, relative to dispersancy and detergency, was defined by developed laboratory techniques. The data subsequently generated revealed that many of the oil concentrates offered very marginal improvement in dispersancy and detergency whereas many created potential performance problems as a result of high foaming tendencies and increases in low temperature fluidity properties. Author (GRA)

N74-14245# General Electric Co., Philadelphia, Pa. Space Div.
INVESTIGATION OF ELECTRONIC CERAMIC FIBERS FOR NON-DESTRUCTIVE EVALUATION OF ADVANCED COMPOSITES Final Report, 16 Feb. 1972 - 30 Jun. 1973
D. R. Ulrich, E. C. Henry, and H. W. Rauch, Sr. 30 Jul. 1973 96 p refs
(Contract N00019-72-C-0285)
(AD-768211) Avail: NTIS CSCL 11/4

The objective was to investigate the feasibility of developing and using crystal-bearing filaments as sensors in the non-destructive evaluation of fiber-reinforced plastic structural materials. The fibers or filaments contain crystalline oxidic materials commonly referred to as electronic ceramics. Compositions investigated include ferroelectric potassium sodium niobate, lithium niobate, lead germanate, lead germanium silicate, lead zirconate titanate, and a magnetic ferrite. These electronic ceramic compositions were dissolved in compatible molten glass, shaped, annealed, and cooled to room temperature. The test shapes (filaments and disks) were then heat-treated to precipitate (exsolve) the material that had been put in solution. Progress is reported in the preparation and processing of these materials. Devitrified filaments were incorporated into test composites, with an epoxy-novalac matrix, and were subjected to preliminary electrical measurements. The effects of glass content and microstructure on electrical properties are reported. Author (GRA)

N74-14246# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
IMPROVED SILICONE FLUIDS AS CANDIDATE GAS TURBINE ENGINE OILS FOR MINUS 40 F TO 465 F TEMPERATURE RANGE Technical Report, Nov. 1971 - Jul. 1972
George J. Morris Jul. 1973 29 p refs
(AF Proj. 7345)
(AD-767898; AFML-TR-73-72) Avail: NTIS CSCL 11/8

A physical and chemical laboratory study of several silicone fluids that represent some of the latest technology in the area has been conducted. These fluids were an alkyl methyl silicone, a trifluoropropyl methyl silicone and a methyl silicone improved by the use of additive formulation. These fluids were investigated for possible use as candidate gas turbine engine oils in the temperature range of -40F to -465F. The viscosity-temperature characteristics, volatility, oxidation stability, corrosion reactivity towards selected metals and lubrication capabilities were assessed for conformance with the recently established specification, MIL-L-27502, covering the aforementioned temperature range. The alkyl methyl silicone, although having favorable rheological and lubrication behavior, was so oxidatively unstable and corrosion prone that further study is not recommended. Both trifluoropropyl methyl silicone and improved methyl silicone have demonstrated sufficient oxidation and corrosion stability to warrant further study. GRA

N74-14247# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
COMPARISON OF CUSHIONING PROPERTIES OF MICROFOAM AND KIMCEL, VERSUS AIR CAP WRAP MATERIALS
Richard V. Brown Aug. 1973 26 p
(AFPEA Proj. 73-9-D-25)
(AD-767233; DSPT-73-54) Avail: NTIS CSCL 13/4

The purpose of this study was to evaluate various plastic wrap materials of foam sheet or flexible cellular structure to determine comparative cost-effectiveness of these materials for various protection levels and loading requirements. Peak G versus Static Stress curves and creep data were developed and compared with like data abstracted from a previous study on a similar wrap material. The data collected in this study indicated that for the fragility levels and static stress regions considered, cost savings of 45 to 50% are possible by careful selection of the correct material. Author (GRA)

N74-14248# Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.
ELASTIC-PLASTIC ANALYSIS OF UNIDIRECTIONAL COMPOSITE UNDER LONGITUDINAL SHEAR M.S. Thesis
Jacob Frank Wechselberger Jun. 1973 98 p refs
(AD-767671) Avail: NTIS CSCL 11/4

The failure point of a unidirectional composite subjected to longitudinal shear loading is calculated. The method of analysis is based on the finite element technique, the incremental plasticity relations of Prandtl-Reuss, and the von Mises yield criterion. The failure point for a boron-aluminum composite and a boron-epoxy composite were computed to determine the effect of the matrix material on the composite. Author (GRA)

N74-14249# Pennsylvania State Univ., University Park. Materials Research Lab.
COMBINED ELLIPSOMETRIC AND SOFT X-RAY SPECTROSCOPIC STUDIES OF CORROSION PROCESSES ON TRANSPARENT MATERIALS
K. Vedam and E. W. White 5 Oct. 1973 29 p refs
(Contract N00014-67-A-0385-0018; NR Proj. 032-523)
(AD-767790; TR-1) Avail: NTIS CSCL 11/2

The feasibility of carrying out systematic and precise surface characterization studies on transparent materials by ellipsometry has been established. Specifically, it is shown that one can detect and quantitatively measure the extent of the damaged surface layers on such transparent materials. Similarly, it is shown that the soft X-ray spectroscopic method can be used to characterize the contaminant film on any material even though the film may be compositionally inhomogeneous. Author (GRA)

N74-14250# National Commission on Materials Policy, Washington, D.C.
COMPENDIUM OF UNIVERSITY FORUMS OF THE NATIONAL COMMISSION ON MATERIALS POLICY, MAY - JUNE 1972. PROCEEDINGS OF THE GEORGIA TECH. FORUM FOR THE NCMP. TOPICS: MATERIALS DETERIORATING, CONSTRUCTION MATERIALS, TEXTILES, AND FORESTRY AND FOREST PRODUCTS, OCTOBER 1972
Allen F. Agnew Aug. 1973 171 p refs Conf. held at Atlanta, 26-28 Jun. 1972
(PB-223680/0GA; NCMP-UF-8) Avail: NTIS HC $10.75 CSCL 05C

The Georgia Tech. Forum examined four general topics by specific consideration of deterioration of synthetic plastics and recycling, transportation and construction materials, nonmetallic minerals of construction, textiles in the USA in the 1980's forest management and land-use conflicts, use of forest residue, and world import functions for the paper industries. GRA

N74-14251# National Commission on Materials Policy, Washington, D.C.
COMPENDIUM OF UNIVERSITY FORUMS OF THE NATIONAL COMMISSION ON MATERIALS POLICY, MAY - JUNE 1972. A BACKGROUND DOCUMENT. NCMP FORUM ON TECHNOLOGICAL INNOVATION IN THE PRODUCTION AND UTILIZATION OF MATERIALS AT PENNSYLVANIA STATE UNIVERSITY, ON 19-21 JUNE 1972
Allen F. Agnew Aug. 1973 223 p refs
(PB-223679/2GA; NCMP-UF-6) Avail: NTIS HC $13.25 CSCL 05C

The Pennsylvania State University Forum discussed, under the general thrust of technological innovation, iron and steel, nonferrous production metallurgy, economics of substitution, polymeric and ceramic materials, coal and synthetic pipeline gas, and the state of the U. S. mineral position. GRA

N74-14670 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 3: STABILITY, CONSTRUCTION MATERIALS, CONSTRUCTION METHODS [FACHGEBIET 3: FESTIGKEIT, WERKSTOFFE, BAUWEISEN]
In its DFVLR Annual Review, 1972 1972 p 151-197 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N74-14252*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
STRUCTURAL ASPECTS OF SYSTEM IDENTIFICATION Ph.D. Thesis
Keith Glover Aug. 1973 131 p refs
(Grant NGL-22-009-124)
(NASA-CR-136557; ESL-R-516) Avail: NTIS HC $8.75 CSCL 12A

The problem of identifying linear dynamical systems is studied by considering structural and deterministic properties of linear systems that have an impact on stochastic identification algorithms. In particular considered is parametrization of linear systems so that there is a unique solution and all systems in appropriate class can be represented. It is assumed that a parametrization of system matrices has been established from a priori knowledge of the system, and the question is considered of when the unknown parameters of this system can be identified from input/output observations. It is assumed that the transfer function can be asymptotically identified, and the conditions are derived for the local, global and partial identifiability of the parametrization. Then it is shown that, with the right formulation, identifiability in the presence of feedback can be treated in the same way. Similarly the identifiability of parametrizations of systems driven by unobserved white noise is considered using the results from the theory of spectral factorization. Author

N74-14253*# Business and Technological Systems, Inc., Seabrook, Md.
J-ADAPTIVE ESTIMATION WITH ESTIMATED NOISE STATISTICS Final Report
Andrew H. Jazwinski and Conrad Hipkins Nov. 1973 49 p refs
(Contract NAS5-22144)
(NASA-CR-132886; BTS-TR-73-5) Avail: NTIS HC $4.50 CSCL 12A

The J-adaptive sequential estimator is extended to include simultaneous estimation of the noise statistics in a model for system dynamics. This extension completely automates the estimator, eliminating the requirement of an analyst in the loop. Simulations in satellite orbit determination demonstrate the efficacy of the sequential estimation algorithm. Author

N74-14254*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MULTIPLE REGRESSION TECHNIQUE FOR Pth DEGREE POLYNOMINALS WITH AND WITHOUT LINEAR CROSS PRODUCTS
John William Davis Washington Dec. 1973 107 p refs
(NASA-TN-D-7422; M-109) Avail: NTIS HC $4.25 CSCL 12A

A multiple regression technique was developed by which the nonlinear behavior of specified independent variables can be related to a given dependent variable. The polynomial expression can be of Pth degree and can incorporate N independent variables. Two cases are treated such that mathematical models can be studied both with and without linear cross products. The resulting surface fits can be used to summarize trends for a given phenomenon and provide a mathematical relationship for subsequent analysis. To implement this technique, separate computer programs were developed for the case without linear cross products and for the case incorporating such cross products

which evaluate the various constants in the model regression equation. In addition, the significance of the estimated regression equation is considered and the standard deviation, the F statistic, the maximum absolute percent error, and the average of the absolute values of the percent of error evaluated. The computer programs and their manner of utilization are described. Sample problems are included to illustrate the use and capability of the technique which show the output formats and typical plots comparing computer results to each set of input data. Author

N74-14255# RAND Corp., Santa Monica, Calif.
A NOTE ON THE BUSY PERIOD OF AN M/G/1 FINITE QUEUE
Louis W. Miller Aug. 1973 15 p refs
(P-5074) Avail: NTIS HC $3.00

Recursive formulas for computing the Laplace-Stieltjes transform and the mean of the distribution of the lengths of busy periods for the M/G/1 queue are derived. Author

N74-14256# RAND Corp., Santa Monica, Calif.
EMPIRICAL BAYES METHODS APPLIED TO SPATIAL ANALYSIS PROBLEMS
Grace M. Carter and John E. Rolph Aug. 1973 26 p refs
(P-5076) Avail: NTIS HC $3.50

A generalization of empirical Bayes estimators to the case in which the components have unequal variance is given. This estimator is applied to the spatial analysis problem of estimating the probability that a fire alarm reported from a particular street box signals a structural fire rather than a false alarm, rubbish fire or other emergency. The approach is to group alarm boxes into relatively homogeneous neighborhoods and to make empirical Bayes estimates of the probability structural for each box in the neighborhood for yearly (1967-1969) Bronx data. The results are evaluated by measuring how a dispatching rule based on the estimates performs on 1970 data. Author

N74-14257# RAND Corp., Santa Monica, Calif.
A CHARACTERIZATION OF LOCAL SOLUTIONS USEFUL FOR SOLVING REVERSE CONVEX PROGRAMS
Richard J. Hillestad Aug. 1973 21 p refs
(P-5066) Avail: NTIS HC $3.25

A solution procedure is described for a class of nonconvex programs defined by constraints and objectives having convexity which is the reverse of that required for a convex problem. Theorems are presented to show that only a finite number of local solutions must be considered in searching for the global minimum. It is also shown that a global solution can be obtained by solving a finite number of convex subproblems under certain broad conditions. Author

N74-14258# Wisconsin Univ., Madison. Mathematics Research Center.
A METHOD FOR THE NUMERICAL SOLUTION OF TWO-POINT BOUNDARY VALUE PROBLEMS BASED ON THE USE OF VOLTERRA INTEGRAL
H. Fujita and L. B. Rall May 1973 47 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-767132; MRC-TSR-1154) Avail: NTIS CSCL 12/1

Suppose that a given two-point boundary value problem to be solved is a perturbation of one for which a considerable amount of analytic information is available, in particular, the Green's function of the unperturbed problem is known. In this case, one can construct an analytic method for the solution of the perturbed problem which involves only the solution of a Volterra integral equation. Discretization of this method, which is a version of the classical shooting procedure, leads to a numerical technique for the solution of perturbed boundary value problems. Under suitable assumptions, convergence of the numerical method is established, and estimates are obtained for the rate of convergence. Attention is devoted to the cases in which the unperturbed differential operator is regular or mildly singular. Linear and nonlinear problems are considered. (Modified author abstract) GRA

N74-14259# Wisconsin Univ., Madison. Mathematics Research Center.
A CANONICAL TRANSFORMATION NEAR A BOUNDARY POINT
L. Sarason Aug. 1973 11 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-767129; MRC-TSR-1350) Avail: NTIS CSCL 12/1

A local homogeneous canonical transformation is constructed which straightens a curved boundary and freezes the coefficients of the principal part of a pseudo-differential operator in the neighborhood of a non-glancing ray. Author (GRA)

N74-14260# Naval Postgraduate School, Monterey, Calif.
SECOND ORDER NECESSARY CONDITIONS FOR PROBLEMS WITH STATE INEQUALITY CONSTRAINTS
I. Bert Russak Jun. 1973 35 p refs
(AD-767697; NPS-53RU73061A) Avail: NTIS CSCL 12/1

A set of second order necessary conditions is obtained for solution to a basic problem in optimal control involving the state constraints psi sup alpha (t,x) < or = 0 alpha = 1,...,m. For the case of a normal solution arc, the methods of Hestenes are used to show that the second variation of a certain functional is non-negative on a class of variations of the solution arc. The results for this problem are basic in the sense that they can be extended to include analagous results for much more complicated problems. Author (GRA)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N74-14261 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie.
METEOROLOGICAL DATA. VOLUME 135, NO. 7: RESULTS OF THE SYNOPTIC SERVICE DURING 1973. DAILY AND MONTHLY WEATHER MAPS (GROUND, 500 mb), TABLES AND BRIEF SCIENTIFIC ARTICLES, JULY [METEOROLOGISCHE ABHANDLUNGEN. BAND 135, HEFT 7: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1973. TAEGLICHE UND MONATLICHE WETTERKARTEN (BODEN, 500 mb), TABELLEN UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE, JULI]
1973 173 p In GERMAN
Avail: Issuing Activity

Meteorological data are presented for the weather conditions over Europe during 1973. Some of the subjects discussed are: (1) dust concentrations, (2) radioactivity levels, (3) climatology of the Northern Hemisphere, (4) temperature conditions in West Berlin, and (5) temperature trends in the free atmosphere of the Northern Hemisphere for the last 20 years. Author

N74-14262 Washington Univ., Seattle.
BAROTROPIC SCALE INTERACTIONS IN THE TROPICAL UPPER TROPOSPHERE DURING THE NORTHERN SUMMER Ph.D. Thesis
Donald Erwin Colton 1973 83 p
Avail: Univ. Microfilms Order No. 73-22561

The general circulation of the tropical and sub-tropical upper troposphere during the northern summer is characterized by large amplitude quasi-stationary waves which create dramatic zonal asymmetries in the seasonal mean flow. Superimposed on this zonally asymmetric monsoonal circulation are transient synoptic scale waves which are also observed to have a strong lingitudinal dependence. A semi-spectral, numerical model is used to investigate the non-linear interactions between the quasi-stationary long waves and transient synoptic waves. Results from a long-term integration of this model show that non-linear barotropic energy exchange between large scale quasi-stationary forced waves and transient synoptic scale waves are important in producing several features of the tropical upper tropospheric general circulation. In particular, the development of such features. Dissert. Abstr.

N74-14263 Pennsylvania State Univ., University Park.
A THREE-DIMENSIONAL NUMERICAL MODEL OF THE SEA BREEZES OVER SOUTH FLORIDA Ph.D. Thesis
Roger Alvin Pielke 1973 146 p
Avail: Univ. Microfilms Order No. 73-24032

A three dimensional shallow, hydrostatic, primitive equation model is used to describe the initiation and evolution of the sea breeze convergence zones over South Florida as a function of the surface heat and momentum fluxes and of the large scale synoptic forcing. The model has eight vertical levels with 1188 grid points at each level. The horizontal resolution is 11 km, except near the lateral boundaries where courser resolution is employed. The large scale synoptic velocity is determined from a balance of the eddy friction, pressure gradient and Coriolis forces. The equations of motion are solved by a semi-implicit forward upstream differencing technique. Vertical velocity is diagnosed by vertical integration. Pressure is calculated hydrostatically from a surface pressure tendency equation and integrated upward to a free surface. Model results are discussed for several different initial conditions. Dissert. Abstr.

N74-14264 Pennsylvania State Univ., University Park.
FACTORS CONTROLLING THE SIZE OF CUMULUS CLOUDS AS REVEALED BY NUMERICAL EXPERIMENTS Ph.D. Thesis
Geoffrey Emmet Hill 1973 159 p
Avail: Univ. Microfilms Order No. 73-24010

A study was made to determine what factors govern the size and spacing of cumulus clouds during the initiation, growth, and fully-developed stages. The investigation was carried out with a two-dimensional numerical model based upon the primitive equations with compressibility retained. In the model development an initial perturbation is replaced by a more realistic mechanism, continuous heating from below. To achieve stability in the numerical integrations, a modification of the Euler-Matsuno scheme is developed. The results of the study show that in the initiation stage the dominant factors governing the size and spacing of cumuli are the size and strength of sub-cloud circulations. In the growth stage the main controlling factors are the size of the circulation in the initiation stage, the production rate of liquid water, and the presence of surrounding circulations. The main factor governing the development of a large multi-cell cloud is the incorporation of smaller surrounding moisture anomalies into the domain of a well-developed cumulus. Dissert. Abstr.

N74-14265*# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
A CONTRIBUTION TO THE SYNOPTIC CLIMATOLOGY OF THE EXTRATROPICS
Srinivasan Srivatsangam Aug. 1973 36 p refs Submitted for publication
(Grant NGR-06-002-098)
(NASA-CR-132894; Paper-203) Avail: NTIS HC $4.00 CSCL 04B

A relationship is established between relative geostrophic vorticity on an isobaric surface and the Laplacian of the underlying layer-mean temperature. This relationship is used to investigate the distribution of vorticity and baroclinicity in a jet-stream model which is constantly recurrent in the winter troposhere. The investigation shows that the baroclinic and vorticity fields of the extratropical troposphere must be bifurcated with two extrema in the middle and subpolar latitudes. This pattern is present in daily tropospheric meridional cross-sections. The reasons for the disappearance of bifurcation in the time-and-longitude averaged distributions are discussed. The implications of the geographical distribution for the maintenance of the observed kinetic energy and baroclinicity distributions in the extratropical troposphere in winter are discussed. It is shown that the subtropical and subpolar ridges are nearly antiparallely distributed as is required by the observed distribution of temporal r.m.s. vorticity at the jet-stream level. Author

N74-14266# Hitachi, Ltd., Tokyo (Japan).
MEASUREMENT OF ENVIRONMENTAL POLLUTION AND ITS SYSTEMIZATION
Kaoru Saka, Junya Sasama, Nobuharu Matsui, Kazuomi Kashiwazako, and Takeshi Arai Jun. 1972 30 p refs Transl. into ENGLISH from Hitachi Hyoron (Japan), v. 54, no. 6, Jun. 1972 p 80-85
(APTIC-42405; TR-294-73) Avail: NTIS HC $3.50

Various instruments which were developed to comply with regulations for measuring air and water pollution are described. Examples of their application in computer systems for pollution surveys are included. Author

N74-14267# Scientific Translation Service, Santa Barbara, Calif.
RECOMMENDATIONS RELATING TO NORMS FOR SULFUR DIOXIDE CONTENT IN OPEN AIR
[1973] 6 p Transl. into ENGLISH from Govt. Air Pollution Board, Common. 6601 (Stockholm), 1967 p 15-19 Sponsored by APTIC
(TR-1176) Avail: NTIS HC $3.00

The corrosion of metals and alloys by sulfur dioxide in the atmosphere is discussed. It is shown that the relative corrosion rate of metals increases with the degree of air pollution. F.O.S.

N74-14268*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
DEVELOPMENT OF AN EXPERIMENT FOR VISIBLE RADIATION MEASUREMENTS FROM A SATELLITE Final Report
Zdenek Sekera and Richard E. Bradbury Washington NASA Nov. 1973 164 p refs
(Contract NAS1-10107)
(NASA-CR-2297) Avail: NTIS HC $4.75 CSCL 04B

The inversion problem, I.E., determining the atmospheric turbidity from polarimetry of radiation emerging from the earth's atmosphere, is presented. A major theoretical advance was made by finding a successful approximation for the forward peak scattering of aerosols together with a simplified characterization of particle size distributions. An engineering model of a multibarreled photopolarimeter suitable for operation from a satellite was evaluated in laboratory and high altitude jet aircraft tests. Comparison of the data from flights over the Mexican desert with theoretical curves for a Rayleigh atmosphere with negligible turbidity is in agreement. Author

N74-14269*# Kansas Univ. Center for Research, Inc., Lawrence.
TOWARD RADSCAT MEASUREMENTS OVER THE SEA AND THEIR INTERPRETATION
J. P. Claassen, A. K. Fung, S. T. Wu, and H. L. Chan Washington NASA Nov. 1973 123 p refs
(Contract NAS1-10048)
(NASA-CR-2328; TR-186-6) Avail: NTIS HC $4.25 CSCL 04B

Investigations into several areas which are essential to the execution and interpretation of suborbital observations by composite radiometer - scatterometer sensor (RADSCAT) are reported. Experiments and theory were developed to demonstrate the remote anemometric capability of the sensor over the sea through various weather conditions. It is shown that weather situations found in extra tropical cyclones are useful for demonstrating the all weather capability of the composite sensor. The large scale fluctuations of the wind over the sea dictate the observational coverage required to correlate measurements with the mean surface wind speed. Various theoretical investigations were performed to establish a premise for the joint interpretation of the experiment data. The effects of clouds and rains on downward radiometric observations over the sea were computed. A method of predicting atmospheric attenuation from joint observations is developed. In other theoretical efforts, the emission and scattering characteristics of the sea were derived. Composite surface theories with coherent and noncoherent assumptions were employed. Author

N74-14270*# Kansas Univ. Center for Research, Inc., Lawrence.
A THEORY OF MICROWAVE APPARENT TEMPERATURE OVER THE OCEAN
S. T. Wu and A. K. Fung Washington NASA Nov. 1973 151 p refs
(Contract NAS1-10048)
(NASA-CR-2329; TR-186-7) Avail: NTIS HC $4.75 CSCL 04B

In the microwave region combined active (scatterometer) and passive (radiometer) remote sensors over the ocean show promise of providing surface wind speeds and weather information to the oceanographer and meteorologist. This has aroused great interest in the investigation of the scattering of waves from the sea surface. A composite surface scattering theory is investigated. The two-scale scattering theory proposed by Semyonov was

specifically extended to compute the emmision and scattering characteristics of ocean surfaces. The effects of clouds and rain on the radiometer and scatterometer observations are also investigated using horizontally stratified model atmospheres with rough sea surfaces underneath. Various cloud and rain models proposed by meteorologist were employed to determine the rise in the microwave temperature when viewing downward through these model atmospheres. For heavy rain-fall rates the effects of scattering on the radiative transfer process are included.
Author

N74-14271# Advisory Group for Aerospace Research and Development, Paris (France).
ATMOSPHERIC POLLUTION BY AIRCRAFT ENGINES
Sep. 1973 405 p refs Mostly in ENGLISH; partly in FRENCH Conf. held at London, 9-13 Apr. 1973
(AGARD-CP-125) Avail: NTIS HC $22.25

The proceedings of a conference on the effects of aircraft engines on atmospheric pollution are presented. The impact of military and civilian aircraft operations on pollution levels are compared with the pollution from other sources. The subjects stressed are: (1) effects of pollution at very high altitudes, (2) effects of pollution near airports, and (3) methods for reduction of pollutant production in combustion processes and in engines. A review of the physiological effects of air pollution is included. For individual titles, see N74-14272 through N74-14306.

N74-14272* New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
REDUCTION OF NO FORMATIONS BY PREMIXING **c06**
Antonio Ferri *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 10 p ref (For availability see N74-14271 05-20)
(Grant NGR-33-016-131)

The effects of exhaust gases from supersonic transport aircraft on the equilibrium of the stratosphere are discussed. A method for reducing the amount of nitrogen oxides generated by the engines of supersonic transports is describes. The engine requirements for the turbojet engines of the supersonic transport aircraft are defined. The design of combustion chambers to provide premixed flames and the thermodynamic properties of premixed flames are analyzed. Charts are developed to show the isotherms of the ignited mixtures for various conditions and the mass fraction of nitrogen oxide along selected streamlines.
Author

N74-14273 Department of Transportation, Washington, D.C.
UNITED STATES DEPARTMENT OF TRANSPORTATION RESEARCH PROGRAM FOR HIGH ALTITUDE POLLUTION
Alan J. Grobecker *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

A review of a United States program to provide an assessment by 1974 of the impact on man, plants and animals of climatic changes due to perturbations of the upper atmosphere by the propulsion effluents of a world high-altitude aircraft fleet as projected to 1990 is presented. Some physical considerations which must be taken into account in this program are described, including representations: of the stratosphere in its unperturbed state, of the effluents of vehicles expected in 1990, of the perturbed stratosphere of 1990, of the perturbed troposphere of 1990 and 2020, of the effects of climatic changes on the biosphere and of social and economic measures of these biological effects.
Author

N74-14274 California Univ., Berkeley. Dept. of Chemistry.
REACTION OF OZONE WITH NITROGEN OXIDES AT HIGH ALTITUDES **c13**
Harold S. Johnston and Gary Whitten *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs Sponsored by DOT (For availability see N74-14271 05-20)

Ozone formation in the stratosphere by the dissociation of oxygen by ultraviolet radiation below 242 nm is discussed. Ozone is removed from the stratosphere by: (1) the reaction of oxygen atoms and ozone, (2) by transport to the troposphere, (3) by catalytic reactions with free radicals based on water, and (4) by catalytic reactions with the oxides of nitrogen. The most important factor in the natural removal of stratospheric ozone appears to be catalytic cycles based on the oxides of nitrogen. The natural source strength has been calculated by three different investigators. There is about a factor of four uncertainty in the natural rate of injection of nitric oxide in the stratosphere. There is about a factor of four uncertainty in the calculated rate of introduction of nitric oxide in the stratosphere from full scale operation of supersonic transports of current and past designs. Within these two ranges of uncertainty, 500 supersonic transports would introduce nitric oxide in the stratosphere at a rate comparable to the known natural sources.
Author

N74-14275 Meteorological Office (Gt. Brit.).
NITROGEN OXIDES, NUCLEAR WEAPON TESTING, CONCORDE AND STRATOSPHERIC OZONE **c13**
P. Goldsmith, A. F. Tuck, J. S. Foot, E. L. Simmons, and R. L. Newson *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 15 p refs (For availability see N74-14271 05-20)

The attenuation of the earth's ozone shield and an increase in the ultraviolet radiation reaching the planetary surface because of aircraft engine exhaust products is examined. It is stated that insufficient investigation has been made of the effects of radiation, photochemistry, and atmospheric circulation on the ozone content. The introduction of nitrogen oxides into the stratosphere through nuclear tests is compared with the amount expected from aircraft operations. Emphasis is placed on the chemical kinetics of heated air. The chemical processes used in calculating the nitrogen oxide production in the hot air masses created by the nuclear shock wave are analyzed.
Author

N74-14276 Pratt and Whitney Aircraft, East Hartford, Conn.
DETAILED EXHAUST EMISSION MEASUREMENTS OF THREE DIFFERENT TURBOFAN ENGINE DESIGNS **c28**
A. W. Nelson *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

A series of test programs was conducted to better define the exhaust emission characteristics of three different aircraft engine models: the JT3D, a low bypass ratio turbofan engine; the JT8D, a mixed flow turbofan engine; and the JT9D, a high bypass ratio turbofan engine. Special investigations were conducted on the JT3D and JT9D engines to investigate inlet temperature and humidity effects. Analysis of these data was supplemented with previously obtained data in order to increase the range of variables investigated. For the mixed flow JT8D engine, special tests were conducted using an engine especially modified to physically separate the fan and core engine streams so that true undiluted emission measurements could be obtained. Three different methods were used to evaluate the emission levels of each engine model: multipoint rake, exhaust case pressure probes and super-detailed traversing. Analysis of the latter method produced highly refined contour plots of CO, THC and NOX emission footprints as well as exhaust temperature and pressure variations at the plane of the tailpipe. The average emission levels obtained by each of the three measurement methods are compared.
Author

N74-14277 Bonn Univ. (West Germany). Inst. fuer Physikalische Chemie.
PHOTO-OXIDATION OF AIRCRAFT ENGINE EMISSIONS AT LOW AND HIGH ALTITUDES **c06**
K. H. Becker and U. Schurath *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 9 p refs (For availability see N74-14271 05-20)

The mechanism of photochemical smog formation is examined. The applicability of photochemical smog formation to aircraft emissions is described. It is concluded that photo-oxidation mechanisms of pollutants from aircraft and other sources in the troposphere undergo fundamental changes with altitude, radical and atom reactions, and probably reactions of metastable oxygen molecules, becoming more important in the colder regions of the troposphere. Serious contamination of the troposphere by aircraft is not expected, because the residence time of pollutants is short compared with emissions rates.
Author

N74-14278 Oslo Univ. (Norway). Inst. of Geophysics.
EFFECT OF SUPERSONIC TRANSPORT UPON THE OZONE LAYER, STUDIED IN A TWO-DIMENSIONAL PHOTOCHEMICAL MODEL WITH TRANSPORT **c13**

Eigil Hesstvedt *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 8 p refs (For availability see N74-14271 05-20)

A steady state two-dimensional model of the stratospheric ozone layer is presented. Photochemical reactions involving oxygen, hydrogen, and nitrogen are considered along with the effect of a parameterized, two-dimensional transport, by mean motion and by eddies. A parameterized meridional distribution of NOx is applied, computed from one-dimensional models. The model is in fair agreement with observed ozone data. The reduction of ozone from emission of NOx from supersonic aircraft is studied, assuming a fleet of 200 aircraft, flying at given altitudes and uniformly distributed over the globe. The effect is found to depend critically upon the flight level. For mid-latitude, summer, the ozone column density is reduced by 0.4% for a flight level of 18 km. For flight levels 23 km and 28 km the reduction is 1.6% and 2.3%, respectively. Accordingly, the increase in UV-radiation amounts to approximately 0.8%, 3.2%, and 4.6% for the same flight levels. Author

N74-14279 Institut d'Aeronomie Spatiale de Belgique, Brussels.

CHEMICAL KINETIC IN THE STRATOSPHERE c13

G. Brasseur *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

The production of ozone in the stratosphere by photodissociation of molecular oxygen is discussed. The specific chemical reactions are analyzed to identify the components involved and the reaction kinetics for various regions of the atmosphere. It is concluded that hydrogen compounds play a significant role in the formation of nitric acid and atmospheric chemical reactions must account for the formation and destruction of hydroxyl and hydroperoxyl radicals. Author

N74-14280 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.

A NEW ANALYTICAL TECHNIQUE FOR CONTINUOUS NO DETECTION IN THE RANGE FROM 0.1 TO 5000 PPM c06

H. Meinel and Th. Just *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 5 p refs (For availability see N74-14271 05-20)

An analytical technique for the continuous detection of small amounts of nitrogen oxide is described. The process is applied to analyzing the amount of nitrogen oxides in engine exhaust gases. A schematic diagram of the ultraviolet resonance absorption nitrogen oxide detector is provided. It is stated that in terms of sensitivity the new method is superior to conventional continuum absorption techniques in the ultraviolet and infrared regions by a factor of ten to thirty. Author

N74-14281 Bristol Univ. (England). Dept. of Aeronautical Engineering.

PROBLEMS OF CHEMICAL POLLUTION BY AIRCRAFT. THE AIRPORT AND ITS IMMEDIATE ENVIRONMENT

T. V. Lawson *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 3 p (For availability see N74-14271 05-20)

The chemical pollution of the airport and its environment is discussed. It calls for a careful study of all surveys so that the inbuilt implications of the model are obvious, and it concludes that the problems of chemical pollution by the aircraft themselves are small. It suggests that much more progress will be made in attempts to reduce pollution around airports by concentrating upon organizations other than the engine manufacturers. It closes by suggesting that authors of technical papers be encouraged to supply an epilogue in which they summarize the findings of their work for the benefit of the lay public. Author

N74-14282 Warren Spring Lab., Stevenage (England). Air Pollution Div.

RELATIVE AIR POLLUTION EMISSIONS FROM AN AIRPORT IN THE UK AND NEIGHBOURING URBAN AREAS

A. W. C. Keddie, J. Parker, and G. H. Roberts *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 9 p refs (For availability see N74-14271 05-20)

Air pollution levels at Stansted Airport in relation to emissions from four nearby towns are discussed. Calculations have been made of pollution emissions from these four sources and also from the airport and the expected contributions from these sources at three local sites have been examined. These values are compared with actual measurements at the three sites. Author

N74-14283 Chemical Defence Experimental Establishment, Porton (England).

GROUND CONTAMINATION BY FUEL JETTISONED FROM AIRCRAFT c13

N. L. Cross and R. G. Picknett IN AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 9 p refs (For availability see N74-14271 05-20)

A study of the problem of ground pollution produced by fuel jettisoned from aircraft under emergency conditions was conducted. The likely size distribution of drops produced when fuel is jettisoned is examined. The proportions of jettisoned fuel which survive evaporation to reach the ground are determined. It is stated that the contamination density on the ground depends on atmospheric stability, wind speed, and direction of flight relative to wind direction. Data obtained from flight tests of jettisoned fuel are presented in tables and graphs. Author

N74-14284 Air Corporations Joint Medical Service (BEA/BOAC), London (England).

POLLUTION LEVELS AT LONDON (HEATHROW) AIRPORT AND METHODS FOR REDUCING THEM

D. M. Bruton *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 6 p ref (For availability see N74-14271 05-20)

Exhaust pollution levels at Heathrow Airport, London, England were conducted. Medical surveys of the interior of buildings were conducted to determine pollution levels. It was determined that pollution levels are below those of many urban areas and do not appear to represent either a short or long range hazard to health. Local pollution problems constitute a source of annoyance to ground personnel employed at the airport. Methods for reducing the exhaust fume emission by vehicle selection, engine tuning, and maintenance practices are recommended. Author

N74-14285 Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.

POLLUTION CONTROL OF AIRPORT ENGINE TEST FACILITIES c11

D. L. Baily, P. W. Tower, and A. E. Fuhs *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 32 p refs (For availability see N74-14271 05-20)

Engine test facilities are required to meet the same environmental standards as any other industrial facility. To meet the standards for smoke, noise, gaseous pollutants, etc. control equipment must be installed. Due to large mass flow rates the control equipment is expensive, careful attention to design is necessary to control costs. Pollution control forces new constraints on exhaust stack temperature, flow uniformity and pressure. Conversely, installation of pollution abatement apparatus may cause adverse operating conditions such as distorted flow into the engine and wrong augmentation ratio. The internal aerodynamics of engine test cells must be mastered to a level not possible previously. Scale models of test cells were fabricated in modules so that some 750 different combinations could be tested. Distortion at the engine face was measured and correlated in terms of component factors. Augmentation ratio and cell depression were measured. An analytical model correctly predicted the measured quantities except for distance from engine nozzle to augmenter inlet. With the data accumulated it should be possible to match pollution control requirements to test cell parameters. Author

N74-14286 Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany). Engine Development and Testing Dept.

EXHAUST EMISSION MEASUREMENTS ON THE GE T64-7 TURBOPROP-ENGINE c28

W. Bergt, G. Kappler, and G. Meikis *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 4 p refs (For availability see N74-14271 05-20)

Exhaust emission measurements have been carried out on the engine GE T64-7 with the objective to determine qualitatively the mass emission of the pollutants carbonmonoxide, unburnt

hydrocarbons and oxides of nitrogen at different power ratings. Although for aircraft engine application the operating modes were just recently issued in the EPA proposed standards for control of air pollution, the engine was run through a 13-point California Test Cycle as applicable to Diesel engines for vehicles up to 6000 lb gross weight. The numerical evaluation of the measured exhaust emissions was carried out using the method of analysis established for the above mentioned test cycle. The measurements were taken for three different types of fuel: JP4, Diesel at 20 C and Diesel at 50 C. The exhaust gas sampling using heated sampling lines and the analytical system set up for the measurements were in agreement with SAE Specifications. The instruments used in the analytical system are shown. Author

N74-14287 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.

NO FORMATION IN FUEL RICH FLAMES: A STUDY OF THE INFLUENCE OF THE HYDROCARBON STRUCTURE **c06**

K. H. Eberius and Th. Just *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 8 p refs (For availability see N74-14271 05-20)

The formation of nitric oxide in premixed propane, ethylene and acetylene flames at 1 atm has been measured. Large overconcentrations of NO were found in very fuel rich flames. The NO formation in flames could be reasonably separated into three classes: (1) Zeldovich mechanism with equilibrium O atom concentration, (2) Zeldovich mechanism with the remaining excess O atom concentration, and (3) other reactions involving radicals as CH, C, C2. The distinction of these classes can be made by studying the temperature dependence of the NO formation, by analysing the curvature of the NO profiles, by relating the rate of NO formation to O atom concentrations and by measuring HCN in some flames. The analysis of the temperature dependence of the NO formation in propane flames gave evidence, that in these flames with stoichiometric ratios between 1.2 and 1.4 and temperatures between 1850 K and 2400 K, reaction class (c) is the main reaction channel. A comparison of flames which have the same temperature at the same mixture strength, but differ in the chemical structure of the fuel, shows higher NO concentrations for acetylene flames and somewhat smaller NO concentrations for methane flames relative to the concentrations in propane flames. Author

N74-14288 Direction Technique Avions, Paris (France). Aerospatiale.

MEASURE OF MINOR CONSTITUENTS IN THE STRATOSPHERE BY CONCORDE 001 [MESURES DES CONSTITUANTS MINEURS DANS LA STRATOSPHERE PAR CONCORDE 001] **c02**

R. Joatton *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 7 p refs In FRENCH (For availability see N74-14271 05-20)

The effect of aerospace vehicles on stratospheric pollution as measured by equipment onboard the Concorde 001 are discussed. Data cover carbon monoxide, several nitrogen oxides, and hydrocarbon emissions. Special attention was given to possible reductions of stratospheric ozone and the effect of such reductions on the environment. Transl. by E.H.W.

N74-14289 National Gas Turbine Establishment, Pyestock (England).

SOOT FORMATION IN RICH KEROSINE FLAMES AT HIGH PRESSURE **c06**

F. H. Holderness and J. J. Macfarlane *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 9 p refs (For availability see N74-14271 05-20)

Soot appearing in gas turbine exhaust products originates within the primary flame. Model combustor experiments are summarized in which soot formation was measured in a reacting kerosine/air flame of uniform composition. Operating conditions are 6 to 21 bar and equivalence ratio 0.8 to 1.8. Chemical equilibrium was not attained for equivalence ratios much above unity. The available oxygen reacted initially with a portion of the fuel, the remainder appearing as pyrolysis product. The total amount of this material, including soot, was roughly dependent on equivalence ratio, independent of other variables. The fraction fully degraded to soot increased sharply on raising pressure from 6 to 11 bar. There was a well defined threshold of soot formation at equivalence ratio 1.3 to 1.4 in premixed flames. Soot was observed at weaker conditions than this in spray flames and the formation rate rose to approximately 10 percent of the input carbon at equivalence ratio 1.8. Author

N74-14290 Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

SOOT OXIDATION KINETICS AT COMBUSTION TEMPERATURES **c06**

John P. Appleton *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 11 p refs (For availability see N74-14271 05-20)

(Grant NSF GK-33933)

Comparisons between soot oxidation rate measurements obtained in laboratory flames and in a recent shock-tube investigation are made with previously reported measurements of the surface oxidation rate of bulk samples of pyrolytic graphite. On the basis of these comparisons it is concluded that the surface oxidation rate mechanisms for soot and pyrolytic graphite are the same and that the rates are predicted by a semiempirical expression, originally proposed for graphite oxidation, which expresses the specific surface oxidation rate in terms of the surface temperature and the gas-phase partial pressure of oxygen. This expression provides a method of estimating soot oxidation rates which is suitable for use in engineering design and performance studies of most practical combustion systems, such as gas-turbine combustors. Author

N74-14291* Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

PARAMETERS CONTROLLING NITRIC OXIDE EMISSIONS FROM GAS TURBINE COMBUSTORS **c28**

John B. Heywood and Thomas Mikus *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 16 p refs (For availability see N74-14271 05-20)

(Grant NGR-22-009-378)

Nitric oxide forms in the primary zone of gas turbine combustors where the burnt gas composition is close to stoichiometric and gas temperatures are highest. It was found that combustor air inlet conditions, mean primary zone fuel-air ratio, residence time, and the uniformity of the primary zone are the most important variables affecting nitric oxide emissions. Relatively simple models of the flow in a gas turbine combustor, coupled with a rate equation for nitric oxide formation via the Zeldovich mechanism are shown to correlate the variation in measured NOx emissions. Data from a number of different combustor concepts are analyzed and shown to be in reasonable agreement with predictions. The NOx formation model is used to assess the extent to which an advanced combustor concept, the NASA swirl can, has produced a lean well-mixed primary zone generally believed to be the best low NOx emissions burner type. Author

N74-14292 California Univ., Berkeley. Dept. of Mechanical Engineering.

FACTORS CONTROLLING POLLUTANT EMISSIONS FROM GAS TURBINE ENGINES **c28**

R. F. Sawyer, N. P. Cernansky, and A. K. Oppenheim *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

(Grants AF-AFOSR-2299-72; AF-AFOSR-2200-72)

Primary pollutants emitted by aircraft gas turbine engines are carbon monoxide, hydrocarbons, aldehydes, smoke, particulates, and nitric oxide. Factors controlling emissions of these pollutants are analyzed on the basis of aircraft engine exhaust composition and laboratory studies of gas turbine combustion processes. Moreover, an analytical prediction of the effect of aircraft operating parameters on the emission of nitric oxide is also given. The formation and destruction of these pollutants were investigated in a laboratory gas turbine combustor. The oxidation of carbon monoxide, hydrocarbons, and aldehydes was measured in the dilution zone where thermal quench phenomena were observed. The apparent oxidation of particulates in the dilution zone was also observed. The formation of nitric oxide was observed in the primary zone and in the first part of the dilution section of the combustor. Operational conditions and

engine parameters were studied analytically, yielding rational criteria for the prediction of their effect on the emmission of nitric oxide. Author

N74-14293 Norwegian Inst. for Air Research, Kjeller.
A SYSTEMATIC APPROACH TO THE STUDY OF THE CONNECTION BETWEEN EMISSION AND AMBIENT AIR CONCENTRATIONS
Knut Erik Groenskei *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 10 p refs (For availability see N74-14271 05-20)

A systematic approach to study the effect of a complex source distribution on the ambient air quality is described. Measurements of emission, meteorological parameters, and ambient air concentrations are used to develop a quantitative model describing the important physical and chemical processes. The model is mathematically formulated in a modified form of the continuity equation for the pollution component. To improve the model, regression analysis can be used. An example of this approach is given in the study of air pollution in Oslo where it has been shown that a systematic vertical motion is the most important process to clean the air in Oslo during inversion situations. Some comments are made on the model approach to the air pollution problem around an airfield. Author

N74-14294 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THEORETICAL STUDY OF THE RESIDUAL EVOLUTION OF POLLUTING PRODUCTS IN TURBOJET EXHAUSTS c28
Roland Borghi *In* AGARD Atmospheric Pollution by Aircraft Engine Sep. 1973 11 p refs In FRENCH; ENGLISH summary (For availability see N74-14271 05-20)

Efforts underway to predict and control the quantity of CO and NO polluting products produced by turbojet nozzle outlets are reviewed. A numerical method, taking into account turbulent mixing phenomena and nonequilibrium chemical reactions, was developed. Several reaction models were compared and show that CO immediately transforms into CO2 upon exhaust. However, a much longer time is needed for NO to disappear. Author

N74-14295 Pratt and Whitney Aircraft, West Palm Beach, Fla.
DEVELOPMENT AND VERIFICATION OF AN ANALYTICAL MODEL FOR PREDICTING EMISSIONS FROM GAS TURBINE ENGINE COMBUSTORS DURING LOW-POWER OPERATION c28
Stanley A. Mosier, Richard Roberts, and Robert E. Henderson (AFAPL) *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 12 p refs (For availability see N74-14271 05-20)

A theoretical combustor model was formulated for predicting concentrations and distributions of unburned hydrocarbons, and carbon monoxide from gas turbine engine combustors. Essential components of this model include an internal flowfield model, a treatment of the physical combustion process, and a treatment of hydrocarbon oxidation kinetics. Model components were incorporated into a computer program with a single model structure for simplicity. An experimental program was also conducted to evaluate combustor design techniques for lowering emission levels and to provide experimental data against which the theoretical model could be tested. Burner exit-plane measurements of unburned hydrocarbons, carbon monoxide, nitrogen oxides, temperature, and pressure were made. Predictions of exhaust species concentrations and distributions were made using the theoretical combustor model in support of the experimental program. Results are discussed with respect to internal aerodynamic and chemical kinetic arguments within the framework of the theoretical formulation. Author

N74-14296 Politecnico di Milano (Italy). Ist. di Macchine.
AN EXPERIMENTAL RESEARCH ON THE BEHAVIOR OF A CONTINUOUS FLOW COMBUSTION CHAMBER c28
C. Casci, A. Coghe, U. Ghezzi, and S. Pasini *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 11 p refs (For availability see N74-14271 05-20)

In relation to the combustion phenomena area, a continuous flow test bench was developed to study gas turbine combustion. The feeding system provided a wide range of air-fuel ratio and working pressure for investigating different test conditions. The combustion chamber was arranged to sample the gas composition in different positions, and to measure other magnitudes such as pressure and air and fuel mass flow rate. The species analyzed were carbon monoxide, unburned hydrocarbon, and nitrogen oxides. The primary concern was the evolution of the above species along the can-type liner and the determination of optimum working conditions. The typical design features of the combustion chamber described allow a comparison of the results obtained to real systems; but the kinetic and fluid dynamic phenomena concerned with the combustion process make the extrapolation of the results difficult for conditions very far from the experimental ones in this research. Author

N74-14297 Air Force Dept., Washington, D.C.
SESSION 4: DESIGN. OPENING REMARKS
W. Moe *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 2 p (For availability see N74-14271 05-20)

Comments are made concerning the design of combustors. Emphasis is placed on the necessity of reducing jet engine pollution without detracting from jet performance. Military involvement in aircraft chemical pollution control is also discussed. K.M.M.

N74-14298 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MODELIZATION OF TURBOMACHINE COMBUSTORS FOR POLLUTION STUDIES c28
Marcel Barrere *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 21 p refs In FRENCH; ENGLISH summary (For availability see N74-14271 05-20)

A survey was made of models currently proposed to calculate the evolution of polluting species in a turbomachine combustor. Efforts were made to improve the models in order to: (1) predict the polluting species generation rate by the combustor for various functioning conditions, (2) determine main parameters acting on this polluting rate, and (3) design new optimized combustors generating a minimum of pollutants while retaining the same performance. Author

N74-14299 California Univ., Berkeley. Dept. of Mechanical Engineering.
SMOKE SUPPRESSANT ADDITIVE EFFECTS ON PARTICULATE EMISSIONS FROM GAS TURBINE COMBUSTORS c28
P. J. Pagni, L. Hughes, and T. Novakov *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 11 p refs (For availability see N74-14271 05-20)
(Grants NSF GK-27895; EPA-AP-385)

The effects of manganese based additives on the mass, size distribution, and chemical composition of particulate emissions from gas turbine combustors are described. Experiments show that the additive, 2-methyl cyclo pentadienyl manganese tricarbonyl, can increase mass emissions if used excessively. The additive shifts the emitted particle size distribution toward many more much smaller particles, thereby reducing visibility primarily by reducing the size of the emmited particles. X-ray photoelectron spectroscopy studies have determined that the chemical state of the emitted manganese is manganese monoxide. It is recommended that combustor redesign and collection techniques be employed whenever possible to suppress particulate emissions from aircraft and test facilities. Author

N74-14300 General Electric Co., Cincinnati, Ohio. Advanced Combustion and Emissions Control Technology.
TECHNOLOGY FOR THE REDUCTION OF AIRCRAFT TURBINE ENGINE EXHAUST EMISSIONS c28
Donald W. Bahr *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

Tests of both production and advanced engines were conducted to determine the emission characteristics of aircraft turbine engines. The results of these engine evaluations are presented. Also presented are the results of exploratory investigations to define and develop design approaches for reducing the carbon monoxide, unburned hydrocarbons, and nitrogen oxides emission levels of high performance, annular combustors - with already developed low smoke emission characteristics. In these latter investigations, the emissions level reductions obtainable through the use of advanced primary combustion zone stoichiometry control methods and advanced

fuel injection techniques were evaluated. In addition, results are presented on the use of water injection techniques to suppress the formation of nitrogen oxides in combustors. It is concluded that future engines can be developed with significantly lower levels of these gaseous emissions than those of current engines. Author

N74-14301 Cranfield Inst. of Technology (England). School of Mechanical Engineering.
A PRELIMINARY STUDY ON THE INFLUENCE OF FUEL STAGING ON NITRIC OXIDE EMISSIONS FROM GAS TURBINE COMBUSTORS c28
A. H. Lefebvre and R. S. Fletcher *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 7 p refs (For availability see N74-14271 05-20)

The results are presented from a preliminary investigation carried out on a tubular aircraft combustor chamber which was perfectly standard apart from an additional fuel injector located just downstream of the primary zone. Measurements of nitric oxide exhaust emissions were carried out over a range of fuel to both primary and secondary zones and the results compared with predictions based on a previously derived mathematical model. Author

N74-14302* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND EVALUATION OF COMBUSTORS FOR REDUCING AIRCRAFT ENGINE POLLUTION c28
Robert E. Jones and Jack Grobman *In* AGARD Atmospheric Pollution by Aircraft Engine Sep. 1973 8 p refs (For availability see N74-14271 05-20)

Various techniques and test results are briefly described and referenced for detail. The effort arises from the increasing concern for the measurement and control of emissions from gas turbine engines. The greater part of this research is focused on reducing the oxides of nitrogen formed during takeoff and cruise in both advanced CTOL, high pressure ratio engines, and advanced supersonic aircraft engines. The experimental approaches taken to reduce oxides of nitrogen emissions include the use of: multizone combustors incorporating reduced dwell time, fuel-air premixing, air atomization, fuel prevaporization, water injection, and gaseous fuels. In the experiments conducted to date, some of these techniques were more successful than others in reducing oxides of nitrogen emissions. Tests are being conducted on full-annular combustors at pressures up to 6 atmospheres and on combustor segments at pressures up to 30 atmospheres. Author

N74-14303 Societe Europeene d'Etudes et d'Essais d'Environnement, Buc (France).
MOTORIST POINT OF VIEW ON THE EFFECTS OF LOW BURNING RATES ON POLLUTION [POINT DE VUE DU MOTORISTE SUR LA CONCEPTION DES FOYERS A FAIBLE TAUX DE POLLUTION] c28
Alain Quillevere, Raymond Briancon, and Jean Decouflet *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 19 p refs In FRENCH (For availability see N74-14271 05-20)

Possible ways of reducing CO, NO, and hydrocarbons emitted by turbojets are discussed by their designers. It was suggested that high performance annular combustion chambers, reduced air speeds, and modification of existing designs may reduce emissions, particularly NO emissions. The use of injector systems to reduce pollution was also examined. Transl. by E.H.W.

N74-14304 Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
AIRCRAFT GAS TURBINE POLLUTANT LIMITATIONS ORIENTED TOWARD MINIMUM EFFECT ON ENGINE PERFORMANCE c28
Robert E. Henderson and William S. Blazowski *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

The proposed Environmental Protection Agency (EPA) regulations for aircraft engine emissions are examined in terms of their impact on the application to military aircraft gas turbine engines. A quantitative assessment of current engine emission levels, design trends, and potential emission control techniques is presented. It is concluded that special considerations must be afforded to military aircraft relative to direct application of EPA regulations; however, many future emission--reducing advances will be applicable to military gas turbines. U. S. Air Force goals were established to insure that new engines take advantage of this technology, and are in accordance, to the greatest degree possible, with what EPA requires of commercial aircraft. These goals are in terms of minimum idle combustion inefficiency, maximum allowable oxides of nitrogen (lb/1000 lb-fuel), and maximum allowable smoke number. The rationale behind using these parameters, and the means by which the numerical limitations were derived, are described. Author

N74-14305 Pisa Univ. (Italy). Ist. di Macchine.
PHOTOMETRIC MEASUREMENTS OF EXHAUST SMOKE TRAILS BY JET ENGINES c33
M. Lucchesini and D. Dini *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 12 p refs (For availability see N74-14271 05-20)

The purpose of this study is twofold: (1) developing a photographic photometry method to measure density and visibility of exhaust smoke trails; and (2) obtaining an objective index for the smoke emission on degree by turbojets. Tests show the P.W. JT8D9 as being one of the most contaminating jet engines in airline service, giving T values of about 74 percent. Transmission T values were measured in many cases at different distances from the nozzle and for several angles between optical and trail axes. This is done to show dependence of T from the aerodynamic airplane/engine configuration and from the optical path L through the trail. Author

N74-14306 Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Toxicology Branch.
ENVIRONMENTAL TOXICOLOGICAL IMPACT OF AIRCRAFT OPERATIONS c13
Kenneth C. Back *In* AGARD Atmospheric Pollutation by Aircraft Engines Sep. 1973 6 p refs (For availability see N74-14271 05-20)

Sources of pollution from aircraft operation include such chemical substances and decomposition products as aviation gasolines, jet fuels, advanced fuels, oils, lubricants, hydraulic fluids, coolants, deicers, and various additives used in these formulations. These may enter the environment as the result of normal mission accomplishment and attendant ground operations, inadvertent malfunctions and spillage, and necessary periodic disposal processes. Physiological effects of the more important compounds which are current problems with aircraft pollutants, problems associated with obtaining such biological data, mechanisms necessary to comply with current pollution control directives, and standards which are now functional are also discussed. Author

N74-14307# Scientific Translation Service, Santa Barbara, Calif.
MEASUREMENT OF AIR POLLUTANTS BY MEANS OF VEGETATION
H. Schoenbeck and H. VanHaut [1973] 18 p refs Transl. into ENGLISH from the publ. "Bioindicators of Landscape Deterioration" Prague, 1971 p 30-38 Sponsored by EPA (TR-653-73; APTIC-57009) Avail: NTIS HC $3.00

The methodology of biological measurement procedures for air pollution is presented. This methodology includes biotests in which the sensitivity of plants to air pollutants is tested. Evaluations can be made based on externally visible signs as well as from comparative chemical investigations of plants to determine their content of certain pollution components. The adequacy of plants as bioindicators is discussed along with exposure procedures and measurements of mediate effects. K.M.M.

N74-14308# Scientific Translation Service, Santa Barbara, Calif.
INVESTIGATION OF THE SUSCEPTIBILITY OF WOODY PLANTS TO SO2 AND HF
J. Mooi [1973] 17 p Transl. into ENGLISH from Groen (Netherlands), Jan. 1972 Sponsored by EPA (TR-227) Avail: NTIS HC $3.00

The susceptibility of plants to air pollution was investigated for SO2, HF, NO2, O3, peroxyacetylnitrate, and ethylene. Results of the susceptibility for various plants to fumigation by the gases

are classified as poor resistance, limited resistance, and great resistance. The magnitude of recovery for the plants is also indicated. F.O.S.

N74-14309# Scientific Translation Service, Santa Barbara, Calif.
GAS CHROMATOGRAPHY METHOD OF DETERMINING THE TOTAL AMOUNT OF ORGANIC SUBSTANCES IN AIR
M. T. Dmitriev, L. N. Tarasova, and L. D. Pribytkov [1973] 6 p refs Transl. into ENGLISH from Gig. Sanit. (USSR), v. 8, no. 37, 1972 p 66-68 Sponsored by APTIC
(TR-305-73; APTIC-47205) Avail: NTIS HC $3.00

A method for analyzing organic matter in air with a flame inonization detector is discussed. The method consists of directly introducing a 5 m1 air sample into the chromatograph, and using the peaks which are recorded to determine the concentration of the organic substance on a carbon scale. F.O.S.

N74-14310# Scientific Translation Service, Santa Barbara, Calif.
POSSIBILITIES OF FORECASTING POLLUTANT CONTENT IN URBAN AIR
L. R. Sonkin 1973 18 p refs Transl. into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol., 1971 p 121-132 Sponsored by EPA
(APTIC-47352; TR-647-73-H) Avail: NTIS HC $3.00

Results are presented of an analysis of meteorologial conditions which govern the significant accumulation of pollutants for the cold season of 1967-1968 in Leningrad, Sverdlovsk, Alma-Ata, Dursk, and Krasnoyarsk. The effects are discussed of wind velocity and direction, temperature and inversions, and the parameter p, which is equal to m/n, where m is the number of observations with concentrations of pollutants in excess of 1.5 times the average seasonal value, and n is the total number of observations. F.O.S.

N74-14311# Scientific Translation Service, Santa Barbara, Calif.
AUTOMATIC GAS ANALYZER AND SOME RESULTS OF THE RECORDING OF CARBON MONOXIDE IN ATMOSPHERIC AIR
E. A. Pevzner and A. S. Zaytsev 1973 12 p refs Transl. into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol., 1971 p 198-204 Sponsored by EPA
(APTIC-46786; TR-647-73-Q) Avail: NTIS HC $3.00

An automatic optical gas analyzer for monitoring and recording microconcentrations of CO in air is described. Results of analyzing the recordings of the CO concentration in an industrial city are presented. It was found that the CO concentration is almost zero at night when there is no auto traffic, and reaches maximums at about 0900, and in the late afternoon, at the end of the work day. F.O.S.

N74-14312# Scientific Translation Service, Santa Barbara, Calif.
SOME RESULTS OF A DETERMINATION OF THE CONCENTRATION OF SULFUR DIOXIDE IN THE FREE ATMOSPHERE
O. P. Petrenchuk and V. M. Drozdova 1973 10 p refs Transl. into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol., 1971 p 178-183 Sponsored by EPA
(APTIC-46783; TR-647-73-N) Avail: NTIS HC $3.00

Measurements by aircraft of the sulfur dioxide content in the free atmosphere near a city in East Europe are reported. The changes in content are presented for stable and turbulent synoptic situations. F.O.S.

N74-14313# Scientific Translation Service, Santa Barbara, Calif.
CHARACTERISTICS OF pH CHANGES IN ATMOSPHERIC PRECIPITATION
R. F. Lavrinenko 1973 10 p refs Transl. into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol., 1971 p 184-189 Sponsored by EPA
(APTIC-46787; TR-647-73-O) Avail: NTIS HC $3.00

Components which determine the pH value, and the influence of the proximity of an industrial city on the pH changes in precipitation were studied for summer and winter. It is concluded that CO2 influences the atmospheric pH value more than any other natural agent. F.O.S.

N74-14314# Scientific Translation Service, Santa Barbara, Calif.
THE SIMULATION OF ATMOSPHERIC TURBULENCE OVER A NONUNIFORM UNDERLYING SURFACE
I. M. Zrazhevskiy and V. V. Klingo 1973 23 p refs Transl. into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol., 1971 p 39-56 Sponsored by EPA
(APTIC-47440; TR-647-73-A) Avail: NTIS HC $3.25

A model for turbulent atmospheric diffusion was studied for simulating velocity profiles and turbulent characteristics of the flow around uneven obstacles on the earth's surface. The effect of coriolis force is applied to the Davydov closed system of equations to derive a scheme for simulating obstacles in the atmosphere, and the derived criteria are analyzed for simulation of air flows in existing wind tunnels. F.O.S.

N74-14315# Scientific Translation Service, Santa Barbara, Calif.
DETERMINATION OF HYDROGEN FLUORIDE IN ATMOSPHERIC AIR
T. A. Kyzmina and N. Sh. Volberg 1973 10 p refs Transl. into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol., 1971 p 172-177 Sponsored by EPA
(APTIC-46784; TR-647-73-M) Avail: NTIS HC $3.00

In order to determine the HF content in atmospheric and industrial air, methods usually used are based on the ability of fluorine to form rather strong colorless compounds with certain multivalent cations and prevent the formation of the colored complexes of these cations with the corresponding organic reagents. Both titrometric and photometric variations of these methods are employed. Back titration was used with a solution of thorium nitrate and an alizarin red indicator. Two photocolormetric methods were used: one based on a disruption of the titanochromotropic complex; another based on the use of compounds of thorium, zirconium, lanthanum, and cerium with various organic reagents. Nontoxic zirconium was used for series determinations of HF in atmospheric air. A study was made of the disturbing influence of SO4 and Al, usually accompanying HF. Author

N74-14316# Scientific Translation Service, Santa Barbara, Calif.
STATISTICAL DETERMINATION OF AVERAGE AND MAXIMUM VALUES OF POLLUTANT CONCENTRATION
E. Yu. Bezuglaya 1973 11 p refs Transl; into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol., 1971 p 133-139 Sponsored by EPA
(APTIC-46890; TR-647-73-I) Avail: NTIS HC $3.00

Observational data were employed concerning sulfur dioxide, carbon monoxide and nitrous oxide from 30 cities to test the possibility of determining maximum concentration of pollutants in the atmosphere. Measurement data from different points, both within a city and for a number of cities, were evaluated for average value of pollutant concentration, its dispersion, the coefficient of variation and probability of pollutant concentration occurence. G.G.

N74-14317# Scientific Translation Service, Santa Barbara, Calif.
ANNUAL AND DAILY PATTERN OF ATMOSPHERIC POLLUTANT CONTENT UNDER URBAN CONDITIONS
E. Yu. Bezuglaya, A. A. Gorchiyev, and Ye. A. Razbegayeva 1973 17 p refs Transl. into ENGLISH from the publ. "Atmospheric Diffusion and Air Pollution" Leningrad, Hydrometeorol, 1971 p 152-161 Sponsored by EPA
(APTIC-47614; TR-647-73-K) Avail: NTIS HC $3.00

Daily and annual variations of pollutants in the atmosphere were studied for planning operation schedules for industries. The

pollutant patterns studied were for dust, sulfur dioxide, nitrogen dioxide, and carbon monoxide. F.O.S.

N74-14318# Kanner (Leo) Associates, Redwood City, Calif.
ESTABLISHING CONCENTRATIONS OF HARMFUL GASES IN THE ATMOSPHERE
Leo Knez Aug. 1973 3 p Transl. into ENGLISH from Nova Proizvod. (Ljubljana), v. 23, no. 1, Jan. - Feb. 1972 p 19
Sponsored by EPA
(TR-17-74) Avail: NTIS HC $3.00

Mathematical equations are provided for calculating percentage volume, percentage by weight, milligrams per liter, grams by cubic meter, or parts per million of toxic gas concentrations in the atmosphere considering their molecular weights. Included are data on maximum permissible concentrations without danger to human health according to international agreement. G.G.

N74-14319# Scientific Translation Service, Santa Barbara, Calif.
THE FORMATION OF ARTIFICIAL FOG ON MOISTURE CONDENSATION NUCLEI
V. I. Saychuk and O. G. Narskikh [1973] 9 p refs Transl. into ENGLISH from Kolloid. Zh. (USSR), v. 2, 1936 p 801-806
Sponsored by EPA
(APTIC-29639; TR-665-73) Avail: NTIS HC $3.00

The production of aerosols (fog, clouds) on chemico-hygroscopic moisture condensation nuclei was investigated to create artificial fogs and clouds under natural conditions. The production of artificial clouds is considered the primary problem in the production of rain. Author

N74-14320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS OF THE STRUCTURE AND CIRCULATION OF THE STRATOSPHERE AND MESOSPHERE, 1971-2
W. S. Smith, J. S. Theon, D. U. Wright, Jr., D. J. Ramsdale, and J. J. Horvath Washington Jan. 1974 96 p refs
(NASA-TR-R-416; G-7408) Avail: NTIS HC $3.75 CSCL 04A

Complete data from a total of 43 meteorological rocket soundings of the stratosphere and mesosphere conducted from Barrow, Alaska; Churchill, Canada; Wallops Island Va.; and Kourou, French Guiana are presented. These data consist of temperature, pressure, density, and wind profiles from 35 acoustic grenade soundings that cover the 30 to 90 km altitude range, and temperature, pressure, and density profiles from 8 pitot probe soundings that cover the 25 to 120 km altitude range. Errors for each of the 35 acoustic grenade soundings are also included. Author

N74-14321# California Univ., Livermore. Lawrence Livermore Lab.
DEVELOPMENT OF AN AIR POLLUTION MODEL FOR THE SAN FRANCISCO BAY AREA Semiannual Report
M. Feldstein, M. C. MacCracken, and R. F. Reinisch 9 Jul. 1973 140 p refs
(Contract W-7405-eng-48)
(UCID-16301; SAR-1) Avail: NTIS HC $9.00

Criteria are presented for the development of an air pollution model for the nine-county San Francisco Bay Area, California. Topics discussed include the choice of monitoring instruments, computer data acquisition and storage systems, and the correlation of meteorological data and air quality measurements. Applications of the model during short-term conditions of increased pollutant emission and for the prediction of annual pollutant concentrations and for land use planning are discussed. NSA

N74-14322# General Dynamics Corp., Chicago, Ill. Electronics Div.
OCEAN BASED INFRARED TEMPERATURE PROFILER Semiannual Report, 1 Jan. - 31 Jul. 1973
C. R. Claysmith 20 Aug. 1973 19 p refs
(Contract N00014-72-C-0175)
(AD-767371) Avail: NTIS CSCL 04/2

During the reporting period the predesign of the temperature/relative humidity profiler (RIAPS 1) was completed, and detailed design drawings are being prepared. Field testing of the present temperature profiler (Sensor 1) has continued, resulting in considerable amounts of data which are being used to optimize the instrument transmission functions, and to determine the overall reliability of the instrument. GRA

N74-14323# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
K SUB a BAND RADAR WEATHER DETECTION
Wilbur H. Paulsen and Pio J. Petrocohi 11 Jul. 1973 41 p
(AF Proj. 6670)
(AD-767594; AFCRL-TR-73-0407; AFCRL-IP-193) Avail: NTIS CSCL 04/2

A scanning K sub a band radar was developed and successfully used in a fog modification program to track both the seeding aircraft and the seeding material that was dispersed from the aircraft over water. This radar showed that the lines of seeding material were separated farther apart than planned due to much higher winds at the aircraft altitude than were expected and tracked the lines of seeding material as they descended and moved in toward the shore. The radar was also used to support other fog modification studies based on the use of heat plumes to evaporate the fog, and an evaluation was made of its usefulness in observing wind directions and wind shears as a function of height. Author (GRA)

N74-14324# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HANDBOOK ON CLIMATE OF THE USSR, ISSUE 3: KARELIAN ASSR; LENINGRAD, NOVOGOROD, PSKOV, OBLASTS. PART 5: CLOUD COVER AND ATMOSPHERIC PHENOMENA
T. A. Pusan, A. D. Lozhkomoeva, A. T. Bychkova, and L. A. Malinina 30 Aug. 1973 96 p Transl. into ENGLISH of the book "Spravochnik po Klimatu USSR, N3: Karelskaya ASSR, Leningradskaya, Novogorodskaya i Pskovskaya Oblasts. Pt5: Oblachnost i Atmosfernye Yavleniya" Leningrad, Gidromet., 1968 p 1-252
(AF Proj. 3005)
(Ad-767944; FTD-HT-23-17-74-Pt-5) Avail: NTIS CSCL 04/2

The report contains statistical data on cloud cover, fog, snowstorms, thunderstorms, and hail as recorded at weather stations in the U.S.S.R. GRA

N74-14325# Naval Postgraduate School, Monterey, Calif.
AN EVALUATION OF HONG KONG HARBOR AS A TYPHOON HAVEN M.S. Thesis
Donald Alan Mautner Sep. 1973 137 p refs
(AD-767660) Avail: NTIS CSCL 04/2

The study evaluates the harbor of Hong Kong as a typhoon haven. Characteristics of the harbor under tropical cyclone conditions, including topographical effects on the wind, storm surge and reliability of moorings and anchorages are discussed and highlighted by two case studies (Typhoon ROSE, August 1971 and Typhoon WANDA, September 1962). Problem areas to be considered if remaining in port and possible evasion procedures for ships sailing from the port are examined for tropical cyclones approaching from various directions. Tropical cyclone tracks for 87 years of data (1884-1970) for the western North Pacific Ocean are examined in order to determine the probability of threat to the port of Hong Kong. Results suggest early sortie action under threatening conditions by all Fleet units capable of evas, California. Author (GRA)

N74-14326# Environmental Prediction Research Facility (Navy), Monterey, Calif.
OCEANIC FOG, A NUMERICAL STUDY Final Report
Edward H. Barker Sep. 1973 74 p refs
(AD-767934; ENVPREDRSCHFAC-tech-paper-6-73) Avail: NTIS CSCL 04/2

A numerical model was developed for the simulation of fog and stratus in the marine planetary boundary layer. Physical processes described by the model are eddy diffusion, horizontal advection, fog droplet settling, infrared radiation and change of thermodynamic state of moist air. Results of the computations show the relative importance of the processes considered in the development of stratiform clouds in the planetary boundary layer. Among the most important factors governing the extent of fog are the magnitudes of horizontal advection of heat and infrared

radiation by cloud and water vapor. Comparisons of the computational results with existing observations show that the formation process has been adequately described. Additionally, it was shown that occurrence of fog over the ocean could result in air temperature colder than that of the sea surface, caused by radiation heat loss from the cloud top. Results indicate that a practical fog forecast model is feasible with certain refinements, such as inclusion of the effects of haze on the infrared radiation balance, inversion strength on the growth of the mixing layer depth, and insolation. Author (GRA)

N74-14327# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CONNECTION OF CLEAR-AIR TURBULENCE WITH THE EVOLUTION OF A PRESSURE FIELD
A. A. Vasilev Sep. 1973 17 p refs Transl. into ENGLISH from Analiz Meteorol. Uslovii dlya Aviats. (USSR), no. 95, 1972 p 27-35
(AD-767892; FTD-MT-24-745-73) Avail: NTIS CSCL 04/2

The probability of Clear Air Turbulence (CAT) significantly increases during flights above frontal lines at the surface of earth and almost does not depend on the features of surface pressure field and barometric tendency. The probability of CAT depends on a change in the geopotential height at flight level. However, this dependence is ambiguous and is determined by the form of the synoptic model. Author (GRA)

N74-14328# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF USING SATELLITE INFORMATION IN NUMERICAL ANALYSIS AND WEATHER FORECASTING
A. I. Burtsev and Sh. A. Musaelyan 6 Sep. 1973 22 p refs Transl. into ENGLISH from Tr. v Vses. Meteorol. S'Yezda. Sektsiya Prognoza Pogody (USSR) v. 2, 1972 p 174-184
(AD-767891; FTD-HT-23-802-73) Avail: NTIS CSCL 04/2

Data on cloud cover distribution and the structure of cloud formations obtainable from weather satellites reflect a complex set of processes which transpire in the atmosphere. This circumstance can be used to determine the parameters of atmospheric conditions which satellites do not currently measure but which are extremely necessary for the purposes of numerical weather forecasting (pressure, wind). The research conducted along these lines has shown that, according to cloud cover data from weather satellites, the wind and geopotential fields can be established. GRA

N74-14329# Army Electronics Command, Fort Monmouth, N.J. Atmospheric Sciences Lab.
OBJECTIVE ANALYSIS USING MODELED SPACE-TIME COVARIANCES: AN EVALUATION
Claud H. Lacy Oct. 1973 58 p refs
(DA Proj. 1T0-61102-B-53 A)
(AD-768159; ECOM-5514) Avail: NTIS CSCL 04/2

A new optimal interpolation type of objective analysis (Eddy's method) is applied to simulated and actual mesoscale data from the National Severe Storms Laboratory and White Sands Missile Range. The effects of data biases on the analysis model are discussed. Methods for estimating the data covariance as a function of space and time separation are discussed and applied to the data. Objectives analyses of the data are made using modeled space-time covariance functions. A sensitivity analysis indicates that the method is not overly sensitive to errors in the estimated parameters. The performance of the method on real and synthetic mesoscale data is compared to that of equally weighted and unequally weighted averages of neighboring stations which were closest in space and time. Frequency response surfaces of averaging and Eddy's method are compared using the geometry of the White Sands Missile Range Network. Author (GRA)

N74-14330# Esso Research and Engineering Co., Linden, N.J. Government Res. Lab.
AIR POLLUTION CONTROL ACTIVITIES IN FOREIGN COUNTRIES. SECOND YEAR OF PROFILE STUDY, SUPPLEMENTAL REPORT
Jun. 1973 681 p refs
(Contract CPA-22-69-68)
(PB-223718/8GA; EPA-450/3-73-001-Suppl) Avail: NTIS HC $12.75 CSCL 13B

A synopsis of air pollution control activities is presented for 35 countries. For each country the profile includes a discussion of geography, political features, current air pollution controls, and future trends, followed by an outline of the relationships among major organizations active in air pollution control. Regional intergovernmental organizations with programs relating to the environment are also indicated. A photographic reproduction of a set of index cards are presented for individual air pollution related organizations in each of the countries covered by the profile texts. Author (GRA)

N74-14331# Hawaii Univ., Honolulu. Water Resources Research Center.
RAINFALL INTENSITY INSTRUMENTS AND MEASUREMENTS Project Completion Report
Charles M. Fullerton and David J. Raymond Jun. 1973 38 p refs
(Contract DI-14-31-0001-3575)
(PB-223010/0; TR-67) Avail: NTIS HC $3.00 CSCL 04B

Two instruments have been used to measure the rate of rainfall from tropical clouds over the windward coast of the Island of Hawaii. The Workman intensity gauge employs strain gauges to sense the deflection in a movable trough and hence the flow of water down the trough. The Raymond-Wilson gauge, a new instrument developed during this program, measures the electrical resistance of flowing water to determine the rainfall rate. These instruments were deployed in a small scale array of eight gauges to measure space and time variations in high intensity rainfall as showers move across the network. Comparative measurements were made with a standard weighing rain gauge, a tipping bucket rain gauge and the Jardi rate of rainfall gauge. Both the Workman gauge and the Raymond-Wilson gauge are clearly superior to the other instruments, because of their rapid response time and their capacity to measure high intensity showers continuously and automatically. (Modified author abstract) GRA

N74-14332# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air and Water Programs.
BACKGROUND INFORMATION ON DEVELOPMENT OF NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS: ASBESTOS, BERYLLIUM, AND MERCURY
Mar. 1973 104 p refs
(PB-222802/1; APTD-1503) Avail: NTIS HC $4.25 CSCL 13B

The document provides a detailed discussion of the statements made in the preamble to the National Emission Standards for Hazardous Air Pollutants (asbestos, beryllium, and mercury). The first section of this report covering general provisions, discusses: applicability of the standards: approval for construction or modification; notification of startup; waiver of compliance; source reporting; source sampling and analytical methods. The three remaining sections discuss the following areas for each of the three pollutants asbestos, beryllium and mercury: (1) health effects; (2) development of the standard; (3) evaluation of comments; and (4) environment impact. GRA

N74-14333# Research Triangle Inst., Durham, N.C.
GUIDELINES FOR DEVELOPMENT OF A QUALITY ASSURANCE PROGRAM. REFERENCE METHOD FOR THE DETERMINATION OF SUSPENDED PARTICULATES IN THE ATMOSPHERE (HIGH VOLUME METHOD) Interim Report
Franklin Smith and A. Carl Nelson, Jr. Jun. 1973 130 p refs
(Contract EPA-68-02-0598)
(PB-223051/4; EPA-R4-73-028b) Avail: NTIS HC $4.50 CSCL 13B

Guidelines for quality control of ambient suspended particulate measurements by the Federal reference method are presented. These include: (1) good operating practices; (2) directions on how to assess data and qualify data; (3) directions on how to identify trouble and improve data quality; (4) directions to permit design of auditing activities; (5) procedures which can be used to select action options and relate them to costs. The report is designed for use by operating personnel. GRA

N74-14334# TRW, Inc., McLean, Va. Transportation and Environmental Operations.
REPORT ON THE COLLECTION AND COMPILATION OF DATA ON POINT SOURCES OF AIR POLLUTANTS

EMISSIONS FOR THE STATE OF MARYLAND AND DISTRICT OF COLUMBIA
27 Oct. 1972 8 p
(Contract DI-68-02-0048)
(PB-222834/4; TRW-9600-017; APTD-1562) Avail: NTIS HC $3.00 CSCL 13B

The scope of the effort on the inventory update is summarized. Section are presented under the headings: power plants, Federal facilities, Maryland facilities, and D.C. facilities. GRA

N74-14335# Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Group.
DETERMINATION OF THE PARTICLE CONTENT OF FLOWING GASES. AN ANNOTATED BIBLIOGRAPHY. 1973 ADDENDUM
E. A. Rouillard May 1973 53 p refs
(PB-223613/1GA; CSIR-SS-O/CHEM-5-Add;
ISBN-0-7988-0191-3) Avail: NTIS HC $4.75 CSCL 14B

The bibliography contains references on sampling and monitoring particulate concentrations in flowing gas streams that came to our attention during the past year. It is an addendum to the bibliography, published in May 1972. GRA

N74-14336# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air and Water Programs.
AIR QUALITY DATA FOR NONMETALLIC INORGANIC IONS 1969 AND 1970 FROM THE NATIONAL AIR SURVEILLANCE NETWORKS
Jun. 1973 80 p
(PB-223630/5GA; APTD-1466) Avail: NTIS HC $3.75 CSCL 13B

Particulate pollutant data gathered during 1969 and 1970 by the cooperating stations of the National Air Surveillance Networks provide the basis for listing the urban and nonurban concentrations of four nonmetallic inorganic ions: ammonium, fluoride, nitrate, and sulfate. Laboratory methodology for each nonmetallic inorganic constituent is described. The data for ammonium, nitrate, and sulfate are presented as cumulative frequency distributions. Author (GRA)

N74-14337# Davis (W. E.) and Associates, Leawood, Kans.
EMISSION STUDY OF INDUSTRIAL SOURCES OF LEAD AIR POLLUTANTS, 1970 Final Report
Apr. 1973 133 p refs
(Contract EPA-68-02-0271)
(PB-223652; APTD-1543) Avail: NTIS HC $4.50 CSCL 13B

Emission study of industrial sources of lead air pollutants has been prepared to provide reliable information regarding the nature, magnitude, and extent of lead emissions from industrial sources in the United States for the year 1970. Background information concerning the basic characteristics of the lead industry has been assembled and included. Brief process description, limited to areas closely related to existing or potential atmospheric losses of lead, are included. Lead emissions and emission factors are presented. Author (GRA)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N74-14338# Illinois Univ., Urbana. Aviation Research Lab.
FLIGHT TESTS OF PILOTAGE ERROR IN AREA NAVIGATION WITH VERTICAL GUIDANCE Interim Report, Dec. 1971 - Aug. 1972
Richard S. Jensen and Stanley N. Roscoe Washington FAA Aug. 1973 130 p refs
(Contract DOT-FA71WA-2574)
(ARL-72-8/FAA-72-2; FAA-RD-72-126) Avail: NTIS HC $8.50

Pilotage error during a complex 18-segment three-dimensional area navigation procedure was measured during 32 simulated instrument flights. The experimental variables were pilot experience level and vertical display type. The major task variable was angle of climb or descent. Pilot performance was measured in terms of altitude, crosstrack, airspeed, and procedural errors. Statistical tests comparing steady-state pilotage error results to previously assumed values show that level flight and three-degree climb altitude errors are not different and three-degree approach altitude error is greater than corresponding values given in DO-152. These tests also show that terminal area crosstrack errors are not different from those previously assumed in AC 90-45. Crosstrack error on three-degree approaches is reliably greater than previously assumed. However, there was no statistically reliable difference between overall performances by airline transport pilots and commercial pilots with instrument ratings for any of the four variables mentioned. Also, there was no statistically reliable difference in altitude control while using the altimeter and while using the vertical deviation indicator in level flight. Relatively frequent procedural errors occurred primarily on intentionally structured high workload segments even after four identical flights using VNAV guidance equipment. Author

N74-14339# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
DESIGN AND USE OF COMPUTER-GENERATED ELECTRONIC AREA NAVIGATION MAP DISPLAYS Final Report, Feb. 1972 - Aug. 1973
Edward Streeter, J. William Weber, and James J. McGrath Aug. 1973 210 p ref
(Contract DOT-FA72WA-2761)
(P73-226; FAA-RD-72-122) Avail: NTIS HC $12.50

Experimental investigations of the following problem areas were performed: (1) time-referenced volumetric navigation in the terminal area using computer-generated electronic map displays, (2) preflight and inflight computer data entry employing keyboard, force controller, and light pen devices, and (3) electronic map display data presentation, alphanumeric legibility, symbol identification, and spacing requirements. A parallel investigation of alternate display generation techniques led to the selection of a design approach for a device suitable for use in a flight simulation facility. The device was mechanized for use with a Raytheon 704 minicomputer in the generation of electronic map displays that provide both area and time navigation guidance. Author

N74-14340# Airborne Instruments Lab., Deer Park, N.Y.
MICROWAVE LANDING SYSTEM (MLS) DEVELOPMENT PLAN AS PROPOSED BY AIL DURING THE TECHNIQUE ANALYSIS AND CONTRACT DEFINITION PHASE OF THE NATIONAL MLS DEVELOPMENT PROGRAM. PART 1.0, VOLUME 1.1: TECHNIQUE ANALYSIS PROGRAM
Washington FAA 27 Sep. 1972 347 p refs
(Contract DOT-FA72WA-2800)
(FAA-RD-73-166-Vol-1.1) Avail: NTIS HC $19.50

The development plan for a microwave landing system is analyzed. The subjects investigated are: (1) system functional requirements, (2) signal format and hardware characteristics, (3) compatibility of proposed system with existing landing systems and aircraft equipment, (4) critical technical areas, and (5) special component development requirements. The objective of the study is to prove feasibility of the concept and to show that the system will be practical and cost effective. Author

N74-14341# Airborne Instruments Lab., Deer Park, N.Y.
MICROWAVE LANDING SYSTEM (MLS) DEVELOPMENT PLAN AS PROPOSED BY AIL DURING THE TECHNIQUE ANALYSIS AND CONTRACT DEFINITION PHASE OF THE NATIONAL MLS DEVELOPMENT PROGRAM. PART 1.0, VOLUME 1.2, BOOK 1: POST TACD DEVELOPMENT PLAN
Washington FAA 27 Sep. 1972 433 p refs
(Contract DOT-FA72WA-2800)
(FAA-RD-73-166-Vol-1.2,1-Bk-1) Avail: NTIS HC $23.75

The test program for evaluation of a microwave landing system is presented. The purpose of the plan is to confirm that the system has the capability of meeting specified functional and operational requirements. The tests which are considered necessary to evalute the performance of the system are defined. The test methods, including flight test phases, are explained. The phases, equipment tested, test objectives, and test facilities are tabulated. Author

N74-14342# Airborne Instruments Lab., Deer Park, N.Y.
MICROWAVE LANDING SYSTEM (MLS) DEVELOPMENT PLAN AS PROPOSED BY AIL DURING THE TECHNIQUE ANALYSIS AND CONTRACT DEFINITION PHASE OF THE NATIONAL MLS DEVELOPMENT PROGRAM. PART 1.0, VOLUME 1.2, BOOK 2: POST TACD DEVELOPMENT PLAN
Washington FAA 27 Sep. 1972 372 p refs
(Contract DOT-FA72WA-2800)
(FAA-RD-73-166-Vol-1.2,2-Bk-2) Avail: NTIS HC $20.75

The various configurations of the microwave landing system are discussed. The variations are developed from the requirements of the organizations using the system. Each variation of the microwave landing system is described in terms of: (1) functional characteristics, (2) azimuth guidance equipment, (3) elevation guidance equipment, (4) distance measuring equipment, and (5) airborne equipment. Circuit diagrams of the electronic components of the system are provided. Author

N74-14343# Airborne Instruments Lab., Deer Park, N.Y.
MICROWAVE LANDING SYSTEM (MLS) DEVELOPMENT PLAN AS PROPOSED BY AIL DURING THE TECHNIQUE ANALYSIS AND CONTRACT DEFINITION PHASE OF THE NATIONAL MLS DEVELOPMENT PROGRAM. PART 3.0, VOLUME 3.1, BOOK 1: COMPILATION OF CRITICAL TECHNICAL AREA REPORTS
Washington FAA 27 Sep. 1972 346 p refs
(Contract DOT-FA72WA-2800)
(FAA-RD-73-166-Vol-3.1,1-Bk-1) Avail: NTIS HC $19.50

The critical technical areas (CTA) involved in the development of a microwave landing system are presented. The CTA's discussed are: (1) curved path utilization, (2) air traffic control interface, (3) auxiliary data utilization, (4) back course utilization, (5) missed approach transition, (6) airborne antennas, and (7) azimuth side lobe suppression. Author

N74-14344# Airborne Instruments Lab., Deer Park, N.Y.
MICROWAVE LANDING SYSTEM (MLS) DEVELOPMENT PLAN AS PROPOSED BY AIL DURING THE TECHNIQUE ANALYSIS AND CONTRACT DEFINITION PHASE OF THE NATIONAL MLS DEVELOPMENT PROGRAM. PART 3.0, VOLUME 3.1, BOOK 2: COMPILATION OF CRITICAL TECHNICAL AREA REPORTS
Washington FAA 27 Sep. 1972 351 p refs
(Contract DOT-FA72WA-2800)
(FAA-RD-73-166-Vol-3.1,2-Bk-2) Avail: NTIS HC $19.75

The critical technical areas (CTA) involved in the development of a microwave landing system are presented. The CTA's discussed are: (1) auxiliary data recovery, (2) auxiliary data interpretation, (3) channel pairing, (4) receiver spurious response analysis, (5) decoder class compatibility, (6) distance measuring equipment, and (7) signal attenuation. Author

N74-14345# Advisory Group for Aerospace Research and Development, Paris (France).
TESTING PHILOSOPHY AND METHODS OF GUIDANCE AND CONTROL SYSTEMS AND SUBSYSTEMS
Oct. 1973 210 p refs Partly in FRENCH and in ENGLISH
(AGARD-LS-60) Avail: NTIS HC $12.50

The proceedings of a conference on performance testing guidance and control systems for aircraft and spacecraft are presented. The subjects discussed are: (1) vertical acceleration tests, (2) centrifuge testing of inertial systems, (3) altitude control unit for sounding rockets, (4) evaluation of electro-optically aided space navigation systems, (5) standardization of software and hardware for test systems, (6) testing of aircraft navigation systems with a high precision reference, and (7) inertial guidance system tests using rocket propelled sleds. For individual titles, see N74-14346 through N74-14356.

N74-14346 Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
INTRODUCTORY REMARKS: TEST TECHNOLOGY TRENDS
Martin G. Jaenke *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 3 p (For availability see N74-14345 05-21)

The trends and approaches taken to solve the problems involved in testing components of inertial navigation systems are discussed. The activities of a test facility are described and importance of reliability analysis as a part of the performance tests is emphasized. The aspects of systems testing which are analyzed are: (1) test accuracy, (2) test stimuli, (3) test dynamics, and (4) test efficiency. Author

N74-14347 Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
PIGA. ACCELERATION TESTS ON VERTICAL 10G, 3 HERTZ TABLE
Michel Corset *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 15 p refs (For availability see N74-14345 05-21)

The characteristics of pendulous gyro accelerometers and methods for conducting vertical acceleration tests are discussed. Mathematical models are developed to describe the primary elements of gyro accelerometer testing. Block diagrams of the test equipment and components are provided. The problems and procedures for conducting acceleration tests on a centrifuge and vibration tests are explained. Author

N74-14348 Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
INERTIAL GUIDANCE SYSTEM CENTRIFUGE TESTING
Richard E. Holdeman *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 15 p refs (For availability see N74-14345 05-21)

The development and characteristics of a centrifuge for testing inertial guidance systems are discussed. The subjects presented are: (1) overall centrifuge capability, (2) test methods and sequence for testing a typical system, (3) instrumentation to monitor all signals for on-line data validation, (4) methods for computer data processing, and (5) test philosophy for evaluating component performance at the system level. Author

N74-14349 Dornier-System G.m.b.H., Friedrichshafen (West Germany).
TESTING OF AN ATTITUDE CONTROL UNIT FOR SOUNDING ROCKETS
Hartmut Siemann *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 8 p (For availability see N74-14345 05-21)

After a general view of the structure of an attitude Control unit for sounding rockets a short description of the equipment available for the test of attitude control systems is given. On this basis a test philosophy is shown which allows a thorough testing of the attitude control unit at optimal costs. This can be done by a test program which examines every phase of the attitude control maneuver completely but without redundancy. Within this scope also environmental tests are dealt with. In the following some practical guidelines for preparation and execution of the tests are given, whereby the engagement of the customer plays a significant role. Author

N74-14350 Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
LABORATORY EVALUATION OF ELECTRO-OPTICALLY AIDED SPACE NAVIGATION SYSTEMS
Walter G. Peterson *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 10 p refs (For availability see N74-14345 05-21)

A key step in any development program is the laboratory testing which provides a means of demonstrating the design concept and hardware performance. The success of this testing is dependent upon both laboratory accuracy and the faithfulness with which the systems' operational environment is duplicated within the laboratory. The greatly increased accuracy and complexity of electro-optically aided space navigation systems that are currently being developed, force the test engineer to devise new test methods in order to insure the validity of his results. This paper seeks to explain the approach that the Central Inertial Guidance Test Facility (CIGTF) is pursuing to meet this challenge. It discusses the way past systems have been tested and the methodology which will be used to evaluate future ones. Author

N74-14351 Elektronik-System G.m.b.H., Munich (West Germany).
TRENDS TOWARDS STANDARDIZED SOFTWARE AND HARDWARE FOR TEST SYSTEMS c14
B. Eichenauer, M. Mall, and G. Schweizer (Dornier-System G.m.b.H.) *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 20 p refs (For availability see N74-14345 05-21)

The use of automatic test equipment for check-out of aircraft before flight is discussed. A check-out system comprises an equipment to stimulate the system to be tested with defined test signals, measuring units, the interconnection system for the connection of all parts with the required test signals and measuring units, the process computer with the interface unit and input/output peripherals. There is a requirement for a variety of different stimuli and measuring units. Examples are ac and dc test signal sources, hydraulic transducers, mechanical transducers, instruments measuring current voltage, power, pressure, rotations. The required software is as important for the operation of a check-out system as the hardware itself. The test procedures for the specific system to be tested, the specification for the stimuli and the measuring units to be applied and the basic software for the computer and the process peripherals as well as the user program for the specific check-out equipment and the system to be tested are all parts of the software complex. Author

N74-14352 Royal Aircraft Establishment, Farnborough (England).
AIRCRAFT INERTIAL SYSTEM TESTING AND EVALUATION IN THE UNITED KINGDOM
R. F. Stokes and S. G. Smith *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 49 p (For availability see N74-14345 05-21)

Internal system testing by Government Departments in the United Kingdom is undertaken by two Establishments - RAE Farnborough and A and AEE Boscombe Down. For historical reasons most flying is done at A and AEE, where a fully instrumented aircraft has been provided for precise navigation trials, but the methods used are largely derived at RAE. Details of the reference equipment available, its advantages and drawbacks, are given, together with a description of the methods used to obtain a high quality, world-wide position and velocity reference. Various methods of obtaining statistical performance parameters are discussed and their consistency is demonstrated. The problems of performance diagnosis are illustrated with a worked example, which also shows the use of a digital mathematical model of an IN system. Some ideas on a possible new approach to inertial system testing are also given. Author

N74-14353 Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
AIRCRAFT NAVIGATION SYSTEMS TESTING WITH A HIGH PRECISION REFERENCE
Melvin Birnbaum *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 11 p refs (For availability see N74-14345 05-21)

The development and characteristics of an aircraft test bed and a Completely Integrated Reference Instrumentation System (CIRIS) are described. The system uses a display system with alphanumeric and graphic representation to provide indications of system operation. The components of the system are illustrated and procedures for conducting the tests are analyzed. Author

N74-14354 Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
INERTIAL GUIDANCE SYSTEM SLED TESTING
G. R. Mozer *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 31 p refs (For availability see N74-14345 05-21)

The techniques used for precision sled testing of inertial and terminal guidance systems and components under high sustained linear accelerations with superimposed vibration on the Holloman fifty-thousand foot, high speed, rocket sled test track are discussed. This track is instrumented with a precision position and time measuring system which measures the sled velocity to better than 0.02 feet/second. Sledborne magnetic tape recorders and radio frequency (RF) telemetry are used to obtain data. Time digitization of guidance system data for automatic computer processing is utilized. Strapped-down and gimballed systems have been tested. Accelerometers are tested in system configuration by installing them on a modified inertial platform. Static calibration of accelerometer bias and scale factor, gyro drift coefficients, and inertial component non-orthogonality measurements are made between sled runs. Accelerometer error models include terms which are a function of steady state acceleration inputs and dynamic acceleration sensitive terms. Propagation of individual error sources, as a function of acceleration profile is examined. Author

N74-14355 Thomson-CSF, Bagneux (France).
ROLE OF SIMULATIONS IN THE STUDY AND DEVELOPMENT OF THE CROTALE SYSTEM
G. Paretti *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 21 p In FRENCH and ENGLISH (For availability see N74-14345 05-21)

After a general description of the CROTALE Weapon System, the main stages of the technical program development are indicated. Then the role of simulations is discussed in further detail and the methodology of their use, on several levels, is stressed. Attention is drawn to the basic character of a constant adjustment of simulations to experimental results. Finally, an application of methodology is illustrated by a practical example, and simulation results are compared to test results. Author

N74-14356 Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.
TERMINAL GUIDANCE SYSTEM TESTING
Felix E. Morgan *In* AGARD Testing Philosophy and Methods of Guidance and Control Systems and Subsystems Oct. 1973 21 p ref (For availability see N74-14345 05-21)

Through the proper combination of complementary non-destructive tests and verification by a limited number of live firings, it is now possible to increase the test cost effectiveness (test validity divided by test cost) for terminally guided weapon systems. These non-destructive tests are conducted under an 'integrated test' concept. This concept dictates complementary tests in varied test arenas, each providing some benefit not available in the others. The results of all these non-destructive tests are then incorporated into a guidance performance propagation computer program to arrive at 'guidance only' total system performance. The validity of the performance propagation for the particular system under test may then be verified by a limited number of live launches. These valid guidance performance indicators can then be combined with non-guidance performance data to predict total weapon system effectiveness over a wider realm of launch parameters. This can also be done at a lower cost than would have been possible utilizing only a large number of live launches. The Guidance Test Division at Holloman AFB, New Mexico, is conducting such integrated tests. This paper presents the detailed descriptions of the test facilities, test methods, and data reduction techniques required to arrive at the performance indicators inputs to the guidance performance propagation computer program. Author

N74-14357# Naval Postgraduate School, Monterey, Calif.
TECHNICAL EVALUATION OF A RADIO DIRECTION FINDING SYSTEM UTILIZING COMPLEMENTARY SEQUENCE PHASE CODING OF INCIDENTS SIGNALS M.S. Thesis
David Louis Prisaznick Jun. 1973 180 p refs
(AD-767684) Avail: NTIS CSCL 17/3

A new radio direction finding system has been proposed which offers advantages over current systems in the areas of bearing accuracy and simplicity of antenna design requirements. The system phase codes the outputs of a linear array of omnidirectional antennas, and then combines these time-separated signals so that the sequences produced uniquely determine the signal arrival angle. A correlation process using matched filters is performed on the resulting sequences in order to determine the corresponding arrival angle. Resolution of the inherent ambiguities of the system, due to elevation angle and adjacent quadrant azimuth components is demonstrated using a two-array technique. A computer simulation of the phase coding/decoding process, using an idealized signal model is used to evaluate the performance of the system for various input

noise conditions, array lengths, and input signal parameters.
Author (GRA)

N74-14358# Naval Postgraduate School, Monterey, Calif.
A MICROCOMPUTER SOLUTION TO MANEUVERING BOARD PROBLEMS M.S. Thesis
Kenneth Harper Kerns and Roger Stuart Cooper Jun. 1973 84 p refs
(AD-767685) Avail: NTIS CSCL 17/7

A special-purpose digital computer has been developed using the new MOS LSI microprocessor technology. The primary goal of this work was to solve a fairly complicated task using a minimal amount of random logic and limited development time. This computing system solves shisp; maneuvering board problems including the determination of course, speed, and closest point of approach of other ships. Ten contacts can be tracked simultaneously. The triangulation involved in these calculations is performed using a decimal version of the CORDIC algorithm. A complete maneuvering situation can be computed in 4.5 seconds. Except for hardware required to drive the displays, all logic is contained in the software-encoded read-only-memory chips, which drive a single CPU chip. Approximately eight hundred man-hours were required to develop the programs and prototype the hardware. The system is modular and easy to maintain, low in bulk, power consumption, and cost. Author (GRA)

N74-14359# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
APPLICATION OF THE AVIONICS MULTIPROCESSOR TO INERTIAL NAVIGATION M.S. Thesis
James A. Haugen Jun. 1973 167 p refs
(AD-768354; GGC/EE/73-5) Avail: NTIS CSCL 17/7

The Burroughs Avionics Multiprocessor System was developed as a flexible avionics computer system. Its flexibility was obtained through microprogrammability and modularity. One of its possible application areas is inertial navigation. The goal was to find the best system configuration and to microprogram it for inertial navigation. After examining the system organization and developing application specifications, it was decided that navigation computer emulation was the best way to apply the system to navigation data processing. This emulator is developed and a testing sequence set up. A program which solves the inertial navigation equations is also developed for the emulator. A program test sequence is given, including two simulated test flight paths. Author (GRA)

N74-14360# National Aviation Facilities Experimental Center, Atlantic City, N.J.
FIELD EVALUATION OF ARTS 2 B (TRACAB) Interim Report, Feb. - Apr. 1973
Robert A. Clark and James F. Akers Oct. 1973 50 p refs
(AD-768203; FAA-NA-73-54; FAA-RD-73-119) Avail: NTIS CSCL 17/7

A programmable ARTS (Automated Radar Terminal System) II B, non-tracking, beacon alphanumeric system was installed in a TRACAB (Terminal Radar Approach Control Cab) configuration in a live air traffic control tower environment. Operational suitability and techniques to be used in the automation program for low-density terminal/towers were evaluated. The system was evaluated over a six-week period through collection of subjective data obtained from controller questionnaires. It was concluded that while suitable for application in a TRACAB (Terminal Radar Approach Control Cab) environment and compatible with the controller, extensive modification to both display subsystem and software were required to improve its usefulness. Author (GRA)

N74-14361# Transportation Systems Center, Cambridge, Mass.
USER'S MANUAL FOR ILSLOC: SIMULATION FOR DEROGATION EFFECTS ON THE LOCALIZER PORTION OF THE INSTRUMENT LANDING SYSTEM
G. Chin, L. Jordan, D. Kahn, S. Morin, D. Newsom, and A. Watson Aug. 1973 91 p
(AD-768049; DOT-TSC-FAA-73-13; FAA-RD-73-76) Avail: NTIS CSCL 17/7

The manual presents the complete ILSLOC computer program package. In addition to including a thorough description of the program itself and a commented listing, the manual contains a brief description of the ILS system and antenna patterns. To illustrate the program a test case was created and the figures of the case are incorporated in the report. Program DYNM and program ILSPLT are included as Appendices. The ILSPLT, complete with sample graphs, is a plotting routine for ILSLOC. For a technical mathematical analysis of the system, the FAA report Instrument Landing System Scattering No. FAA-RD-72-137 should be consulted. Author (GRA)

N74-14362# Tactical Air Warfare Center, Eglin AFB, Fla.
SIMPLIFIED VISUAL APPROACH SLOPE INDICATOR (VASI) Final Report, 16 Apr. - 31 Jul. 1973
James F. Yealy Sep. 1973 28 p
(AD-767901) Avail: NTIS CSCL 17/7

The purpose of this operational test and evaluation was to determine the value of a simplified visual approach slope indicator (VASI) system to the USAF Special Operations Force by accomplishing three test objectives; formulate and document construction criteria, establish user acceptance/rejection, and incorporate an air-transportable capability. Two types of systems were designed and constructed for user evaluation. Both were identical except for the support arrangement. One system was embedded in the ground, and the other was anchored to the ground by using sandbags. Both systems could be transported by air. Two hundred and eighty approaches were flown against the systems by 61 different pilots. The majority of pilots indicated that the systems were effective beginning at distances ranging from 1/2 to 1 mile and ending at 25- to 50-foot altitude (approximately 450 to 950 feet in front of the boards) during night or daytime operation. The best color combination was determined to be black stripe on white background. It was recommended that USAF Special Operations Force retain the two systems for potential future use during deployments to austere bases, temporary airfields, and landing zones not equipped with standard VASI. Author (GRA)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N74-14363*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ISOTOPE HEAT SOURCE SIMULATOR FOR TESTING OF SPACE POWER SYSTEMS
George M. Prok and Robert B. Smith Washington Dec. 1973 15 p refs
(NASA-TM-X-2962; E-7616) Avail: NTIS HC $2.75 CSCL 18I

A reliable isotope heat source simulator was designed for use in a Brayton power system. This simulator is composed of an electrically heated tungsten wire which is wound around a boron nitride core and enclosed in a graphite jacket. Simulator testing was performed at the expected operating temperature of the Brayton power system. Endurance testing for 5012 hours was followed by cycling the simulator temperature. The integrity of this simulator was maintained throughout testing. Alumina beads served as a diffusion barrier to prevent interaction between the tungsten heater and boron nitride core. The simulator was designed to maintain a surface temperature of 1311 to 1366 K (1900 to 2000 F) with a power input of approximately 400 watts. The design concept and the materials used in the simulator make possible man different geometries. This flexibility increases its potential use. Author

N74-14364*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXAMINATION OF T-111 CLAD URANIUM NITRIDE FUEL PINS IRRADIATED UP TO 13,000 HOURS AT A CLAD TEMPERATURE OF 990 C
Jack G. Slaby and Byron L. Siegel Washington Dec. 1973 46 p refs

(NASA-TM-X-2950; E-7579) Avail: NTIS HC $3.00 CSCL 18H

The examination of 27 fuel pins irradiated for up to 13,000 hours at 990 C is described. The fuel pin clad was a tantalum alloy with uranium nitride as the nuclear fuel. Two nominal fuel pin diameters were tested with a maximum burnup of 2.34 atom percent. Twenty-two fuel pins were tested for fission gas leaks; thirteen pins leaked. Clad ductility tests indicated clad embrittlement. The embrittlement is attributed to hydrogen from an n,p reaction in the fuel. Fuel swelling was burnup dependent, and the amount of fission gas release was low, generally less than 0.5 percent. No incompatibilities between fuel, liner, and clad were in evidence. Author

N74-14365# RAND Corp., Santa Monica, Calif.
CHARACTERISTICS OF RADIOISOTOPE POWER SOURCES IN AN OCEAN ENVIRONMENT
R. C. Erdmann, E. C. Gritton, and M. J. Ozeroff Jul. 1973 30 p refs
(P-5056) Avail: NTIS HC $3.50

The results of this study show that light weight radioisotope heat sources can be considered for use undersea with little or no shielding necessary for electronic compartments in close proximity to the heat source. Acceptable integrated electronic dose levels of 10 to the 7th power rads for gamma irradiation and 10 to the 4th power reps for neutron bombardment were obtained for useful mission times and shielded electronics volume. It is unnecessary to shield the isotope Po-210 for electronic protection. However, reuse might be precluded because of its short half-life and this isotope could present special heat management problems not encountered with either Co-60 or Cm-244. For Cm-244 and Co-60 it was found that the shield around the electronics package becomes very important due to the strong back scattering effect of neutrons and gammas from the surrounding seawater. Recovery of an isotope-powered undersea electronics package must be done remotely. It will be necessary to provide shielding to protect personnel engaged in the retrieval of the package (and also in the initial launching) and this shield will be extensive to provide for attenuation to biologically acceptable levels. Author

N74-14366*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED-POWER-REACTOR DESIGN CONCEPTS AND PERFORMANCE CHARACTERISTICS
Harry W. Davison, Thomas A. Kirchgessner, Roy H. Springborn, and Howard G. Yacobucci Washington Jan. 1974 22 p refs
(NASA-TM-X-2957; E-7614) Avail: NTIS HC $2.75 CSCL 18I

Five reactor cooling concepts which allow continued reactor operation following a single rupture of the coolant system are presented for application with the APR. These concepts incorporate convective cooling, double containment, or heat pipes to ensure operation after a coolant line rupture. Based on an evaluation of several control system concepts, a molybdenum clad, beryllium oxide sliding reflector located outside the pressure vessel is recommended. Author

N74-14367# Atomics International, Canoga Park, Calif.
DESIGN AND INTEGRATION OF ZIRCONIUM HYDRIDE REACTOR POWER SYSTEMS
J. H. VanOsdol, (ed.) 30 Jun. 1973 208 p refs
(Contract AT(04-3)-701)
(AI-AEC-13072) Avail: NTIS HC $7.60

The SNAP Zirconium Hydride (ZrH) Reactor Program supported reactor and associated component development, system development, and a variety of application and integration studies. The key technical aspects of each of these components and subsystems are summarized. The technology status of each is presented. Operational characteristics of ZrH reactor systems are discussed. The application studies which were conducted are summarized. The components and subsystems presented are: reactor, shielding, various power conversion systems, heat rejection systems, liquid metal components, and support structure. The applications summarized are: lunar base, space station, space base, communications satellites, space shuttle integration, surveillance satellites, hardened missile bases, terrestrial power systems, and marine systems. Author (NSA)

N74-14368# Tokyo Shibaura Electric Co., Ltd. (Japan).
STUDIES ON SWELLING OF FAST REACTOR FUEL CAUSED BY GASEOUS FISSION PRODUCTS. 2: OUT-OF-PILE EXPERIMENTS ON EDUCTION BEHAVIOR OF FISSION-PRODUCED GASEOUS BUBBLES
Y. Iwano, I. Tanabe, and N. Ohi Feb. 1972 30 p refs
(JAPFNR-117; PNC-J-201-72-2) Avail: AEC Depository Libraries HC $3.50

Irradiated UO2 samples were annealed under high temperature and high pressure conditions. The eduction behavior of fission produced gaseous bubbles in the irradiated UO2 was observed by means of replica electron microscopy, and its resulting effect was studied in comparison with the case of an atmospheric pressure annealing. It was found that when an external pressure is applied, there is very little eduction of fission produced gas bubbles in the crystal grains, and also that the size of gas bubbles produced in the crystal grain boundaries become smaller than in the case of atmospheric pressure annealing. As a unique phenomenon of an external pressure annealing, there was observed an eduction of fission produced gaseous bubbles in network on the crystal grain boundaries. An investigation was undertaken as to the reason for nondetection of fission produced gaseous bubbles inside the crystal grains under high pressure. Author (NSA)

N74-14369# Mound Lab., Miamisburg, Ohio.
BIFOLD NUCLEAR POWER SOURCE
R. A. Wolfe and W. F. Stubbins 15 Aug. 1973 195 p refs
(Contract AT(31-1)-gen-53)
(MLM-1982) Avail: NTIS HC $7.60

The BIFOLD nuclear power source, whose name denotes two distinctly different means of energy release in a single device, joins SNAP isotopic heat source and SNAP reactor technology to provide reliable uninterruptable base power which is augmented during periods of high demand power by operation in a critical reactor mode. The fuel, Pu-238 is an alpha emitting heat source isotope which is able to form a small critical system. BIFOLD is a small compact power source using heat pipes with thermoelectric or other energy converting components operating in an isothermal state at its base power of 11 kW(t) or more to meet demand power needs. The split core of BIFOLD permits all operational tests to be completed economically with zero power reactor operation which avoids induced radioactivity in components and the build-up of fission fragment inventory. Detailed reactor analyses were made of various configurations of fuel, reflector, heat removal penetrations, controls, and so forth, to yield critical masses and lifetimes. Author (NSA)

N74-14370# Atomics International, Canoga Park, Calif.
ZIRCONIUM HYDRIDE REACTOR CORE HYDRAULIC STUDIES Summary Report
B. J. Ostermier 30 Jun. 1973 124 p refs
(Contract AT(04-3)-701)
(AI-AEC-13087) Avail: NTIS HC $8.25

A summary is presented for the series of water hydraulic tests performed to evaluate the flow characteristics of the various zirconium hydride reactors. Test models, test methods, instrumentation, and results are described. Tests were conducted to develop inlet plenum configurations and fuel element fin configurations. Inlet plenum configurations were evaluated on their ability to produce desired in-core flow distributions, and to provide a uniform pressure at the inlet grid plate surface without any undesirable flow characteristics. A series of inlet plenum tests was also conducted to determine any flow behavior which might have contributed to the operational problems of the S8DR. Fuel element fin configurations were evaluated on their ability to produce interchannel flow mixing within the reactor core. Pressure drop determinations were made for all plenum and fuel element fin configurations. NSA

N74-14371# Oak Ridge National Lab., Tenn.
THERMONUCLEAR DIVISION Annual Progress Report, period ending 31 Dec. 1972
Jul. 1973 58 p refs Sponsored by AEC
(ORNL-4896) Avail: NTIS

Three distinct categories distinguished by the associated experimental program are considered: (1) confinement and heating in Tokamak devices; (2) high beta equilibrium and stability,

motivated primarily by the ELMO, canted mirror, and ELMO bumpy torus experiments; and (3) plasma formation and confinement in magnetic mirrors. Within each major category various questions have been addressed. NSA

N74-14372# Atomics International, Canoga Park, Calif.
SNAP 2: SUMMARY REPORT
A. A. Jarrett 27 Jul. 1973 192 p refs
(Contract AT(04-3)-701)
(AI-AEC-13068) Avail: NTIS HC $7.60

The development history of the SNAP 2 concept is presented. The program was originally oriented toward the development of a specific 3-kW(e) Mercury Rankine cycle system powered by a hydride reactor. Subsequently, the program was directed toward a broader technology development of the engineering feasibility of large systems for space applications into the 100- to 200-kW(e) range. The initial critical assembly of the reactor concept, and the power, temperature, and life demonstration by the SNAP Experimental Reactor (SER) and the SNAP 2 Developmental Reactor (S2DR) are described. The development of components of the power conversion system, called the combined rotating unit (CRU), which has all rotating components mounted on a single common shaft, is summarized. Other major component developments described are: (1) the mercury boiler-superheater; (2) the radiator-condenser heat rejection system; and (3) the thermo-electromagnetic pump. Author (NSA)

N74-14373# Atomics International, Canoga Park, Calif.
SNAP PROGRAMS: SUMMARY REPORT
D. W. Staub, ed. 30 Jul. 1973 208 p refs
(Contract AT(04-3)-701)
(AI-AEC-13067) Avail: NTIS HC $7.60

The overall SNAP reactor programs, covering the period from 1951 through 1973, are summarized. The following programs are reviewed: SNAP 2, SNAP 4, SNAP 8, SNAP 10A, 5-kW(e) program, and the SNAP reactor aerospace safety program. Author (NSA)

N74-14374# Atomics International, Canoga Park, Calif.
SNAP 4 SUMMARY REPORT. VOLUME 1: APPLICATIONS AND SUMMARY
J. R. Wetch 20 Jul. 1973 49 p
(Contract AT(04-3)-701)
(AI-AEC-13069-Vol-1) Avail: NTIS HC $4.00

The AEC-sponsored SNAP 4 Program provided the basis for the conceptual design of a compact reactor system employing uranium-zirconium hydride for fuel and moderator, beryllium reflectors for control, and forced-convection boiling water for cooling. The completely self-contained, compact, multipurpose, automatically controlled, transportable nuclear reactor was directly coupled, through a stream separator, to a high-speed, hermetically sealed, turbine-generator unit. The turbine exhausted to a compact high-pressure condenser, and small stream driven turbo-pumps returned the condensate to the reactor. The complete system, which could be designed and built for a specific power rating in the range from 400 to 4,000 kW(e), is adaptable to marine or terrestrial, surface or submerged, fixed or mobile, and arctic or tropic environment. Author (NSA)

N74-14375# Atomics International, Canoga Park, Calif.
SNAP 4 SUMMARY REPORT. VOLUME 2: SYSTEMS DESCRIPTION
A. R. Marchese, ed. 18 Jul. 1973 354 p refs
(Contract AT(04-3)-701)
(AI-AEC-13069-Vol-2) Avail: NTIS HC $19.75

The technical activities conducted during the period from 1960 to 1965 on the SNAP 4 Program are summarized. The overall objective was to develop a multipurpose, automatically controlled, transportable, compact nuclear power system. The concept consists of a uranium-zirconium hydride alloy fueled and moderated, beryllium reflector controlled, forced convection boiling water cooled, compact reactor. The reactor is directly coupled, through a stream separator, to a high-speed hermetically sealed turbine generator unit. The turbine exhausts to a compact high-pressure condenser, and small stream driven turbo-pumps to be readily transportable by air, land, rail, or water, and suitable for multipurpose applications which require power in the range of 500 to 4000 kW(e). Author (NSA)

N74-14376# Atomic Energy Commission, Washington, D.C.
SAFETY OF NUCLEAR POWER REACTORS (LIGHT WATER-COOLED) AND RELATED FACILITIES
Jul. 1973 510 p refs
(WASH-1250) Avail: TIC Free

Descriptions are included of light water nuclear power plants and related facilities, basic philosophy and practices for assuring safety, the government's regulatory role, radioactive effluents, evaluations of postulated accidents, current approaches to the assessment of societal risks, the water-reactor safety research program, and selected topics in areas of special interest. Background material, information on the discharge of heat to the environment, and a discussion of public attitudes are also included. NSA

N74-14377# Oak Ridge National Lab., Tenn.
ISOTOPE KILOWATT PROGRAM Quarterly Progress Report, period ending 31 Mar. 1973
A. P. Fraas and G. Samuels Sep. 1973 28 p refs
(Contract W-7405-eng-26)
(ORNL-TM-4243) Avail: NTIS HC $3.50

Work in progress on developing a 1 to 10 kW radioisotopefueled energy conversion system for terrestrial and undersea use is described. Information is included on: facilities for decomposition testing of materials being evaluated as a working fluid for an organic Rankine cycle conversion system; decomposition test results which indicated that the gas volume evolved in capsules loaded with Dowtherm A was much higher than for capsules containing material produced by the Eastman Kodak Co.; performance testing of fusible insulation; and thermal and impact testing of fuel capsules. NSA

N74-14378# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
PULSED NUCLEAR REACTOR AND HEAT ENGINE IN A SINGLE UNIT: ESSAY ON THE DIRECT CONVERSION OF THE NUCLEAR ENERGY INTO MECHANICAL ENERGY
G. Cristea 1973 10 p
(IFA-FR-103-1973) Avail: AEC Depository Libraries HC $3.00

Design parameters are presented for gas fueled pulsed reactors which are presented for gas fueled pulsed reactors which are arranged in horizontal alignment and which are pulsed by a reciprocating piston between the reactors. NSA

N74-14614* Pioneer Service and Engineering Co., Chicago, Ill.
SOME STUDIES ON THE USE OF NASTRAN FOR NUCLEAR POWER PLANT STRUCTURAL ANALYSIS AND DESIGN
Achyut V. Setlur and Muniratham Valathur *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 585-594 refs (For availability see N74-14586 05-32)
CSCL 18I

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology; and 29 Space Radiation.

N74-14379 Connecticut Univ., Storrs.
THE SPECTRUM OF TURBOMACHINE ROTOR NOISE CAUSED BY INLET GUIDE VANE WAKES AND ATMOSPHERIC TURBULENCE Ph.D. Thesis
Donald Burnett Hanson 1973 142 p
Avail: Univ. Microfilms Order No. 73-24404

A theoretical methodology is developed to calculate the partially coherent acoustic radiation of propellers, helicopter rotors, and axial flow fans due to inflow turbulence which is not

plots of experimental data. The methodology is applied to two important cases: in the first case the rotor inflow contains non-homogeneous turbulence in the wakes of inlet guide vanes (IGV's) and in the second case it contains the turbulence ingested from the atmosphere which is highly anisotropic at low or zero forward flight speed. Dissert. Abstr.

N74-14380 Catholic Univ. of America, Washington, D.C.
AN ULTRASONIC STUDY OF THE NORMAL-STATE ELECTRONIC PROPERTIES OF PURE NIOBIUM: ANOMALOUS ZERO FIELD ATTENUATION AND THE MAGNETO-ACOUSTIC EFFECT Ph.D. Thesis
Gerald Vincent Blessing 1973 124 p
Avail: Univ. Microfilms Order No. 73-22643

An anomaly in the temperature dependence of the normal-state shear wave attenuation alpha sub N, the appearance at low temperatures of a maximum which shifts with frequency, has been investigated. The effect is not influenced by wave polarization orientation in the (100) plane. A computer analysis of low frequency alpha sub N data, for which the anomaly was absent near T sub, was used to obtain a functional relationship for the electron mean free path l(T). The phonon limited mean free path was found to have a T 4.3 dependence in the range 7 deg to 12 K. These results for l(T) show that the alpha sub N(T) maxima occurred at an essentially fixed ql value over a range of discrete frequencies from 195 to 435 MHz. A magnetoacoustic study of niobium's Fermi surface structure found that the magnetoacoustic interaction only favors the inclusion of selected closed sheets from the Fermi surface. Dissert. Abstr.

N74-14381 Cincinnati Univ., Ohio.
MAGNETIC PROPERTIES OF NEODYMIUM-SAMARIUM-COBALT ALLOYS Ph.D. Thesis
William George DeMott Frederick 1973 129 p
Avail: Univ. Microfilms Order No. 73-22753

A vibrating sample magnetometer was utilized to determine the magnetization parallel and perpendicular to the c-axis of single crystals of YCO5 and the pseudo-binary alloy system Nd-xSmxCO5 over the temperature range from 4.2 to 1000 K. The saturation magnetization was determined from an extrapolation of an isothermal magnetization curve in the easy direction to zero magnetic field. The Curie temperature was derived from the temperature dependence of the remanent magnetization. Dissert. Abstr.

N74-14382*# General Electric Co., Philadelphia, Pa.
THE RADIOMETER TRANSFER FUNCTION FOR THE AAFE COMPOSITE TWO-FREQUENCY RADIOMETER SCATTEROMETER M.S. Thesis - Pennsylvania Univ.
J. H. Moore Washington NASA Dec. 1973 77 p refs Sponsored by NASA
(NASA-CR-2343) Avail: NTIS HC $3.75 CSCL 14B

A model was developed for the switching radiometer utilizing a continuous method of calibration. Sources of system degradation were identified and include losses and voltage standing wave ratios in front of the receiver input. After computing the three modes of operation, expressions were developed for the normalized radiometer output, the minimum detectable signal (normalized RMS temperature fluctuation), sensitivity, and accuracy correction factors). * Author

N74-14383*# Scientific Translation Service, Santa Barbara, Calif.
REPRESENTATION OF HOT JET TURBULENCE BY MEANS OF ITS INFRARED EMISSION
J.-F. DeBelleval and M. Perulli Washington NASA Dec. 1973 24 p refs Transl. into ENGLISH from Office Natl. d'Etudes et de Rech. Aerospatiales (France), report tp-1277, 17-21 Sep. 1973 10 p
(Contract NASw-2483)
(NASA-TT-F-15233; TP-1277) Avail: NTIS HC $3.25 CSCL 20A

The theoretical description of a jet acoustic radiation is characterized by turbulence data, defined at the scale of the total emissive volume. These data have average values in time, i.e. representing the whole spectrum. A representation of a hot jet turbulence by means of crossed spectral densities is presented. It is possible to define at any point of the source volume the characteristics turbulence data by frequency bands. Author

N74-14384*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SONIC INLET NOISE ATTENUATION AND PERFORMANCE WITH A J-85 TURBOJET ENGINE AS A NOISE SOURCE
Harold W. Groth 1974 14 p refs Proposed for presentation at 12th Aerospace Sci. Meeting, Washington, D. C., 30 Jan. - 1 Feb. 1974
(NASA-TM-X-71488; E-7823) Avail: NTIS HC $3.00 CSCL 20A

A static test program was conducted to investigate aerodynamic and acoustic performance of a sonic inlet used as a noise suppressor. A translating centerbody type inlet with radial vanes was tested ahead of a J85-GE-13 turbojet engine. The inlet when fully choked, maintained high recovery with low distortions while dramatically reducing noise emanating from the compressor. Recoveries of 98.1% at simulated takeoff and 95% at approach were attained with associated sound attenuation of 40 db and 38 db respectively. Inlet lip shape was found to have significant effects on noise attenuation at these static conditions. Author

N74-14385*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
ALGEBRAICALLY GROWING WAVES IN DUCTS WITH SHEARED MEAN FLOW
Ali Hasan Nayfeh and Demetri P. Telionis Apr. 1973 12 p refs
(Contract NGR-47-004-109)
(VPI-E-73-11) Avail: NTIS HC $3.00 CSCL 20A

Standing or traveling waves which vary algebraically with the axial distance in uniform ducts with sheared mean velocity profiles are investigated. The results show that such waves are not possible for ducts with uniform cross sections and fully developed mean flows. Author

N74-14386*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PEFORMANCE EVALUATION OF A PASSIVE MICROWAVE IMAGING SYSTEM
William E. McAllum Nov. 1973 30 p refs
(NASA-TM-X-58109; JSC-08656) Avail: NTIS HC $3.50 CSCL 14B

A test program was conducted to evaluate the passive microwave imaging system for possible application in the NASA Earth Resources Program. In addition to test data analysis, the report gives a brief description of the radiometer, its software, and the ground support equipment. The microwave image quality is adequate for remote sensing applications studies. Instrument problems are described, and suggestions are given for possible improvements and potential applications. Author

N74-14387# Washington Univ., Seattle. Dept. of Electrical Engineering.
HOLOGRAPHICALLY GENERATED LENSES
Andreas Richter and F. Paul Carlson Sep. 1973 34 p refs
(Contract N00014-67-A-0103-0024; NR Proj. 350-005)
(AD-768201; UW-TR-167) Avail: NTIS CSCL 20/6

A holographic lens has been made which uses earlier work on holographic aberration correction. The lens properties are obtained by interferometrically recording a plane wave and a pinhole spherical wave. The lens was tested by means of the methods of the Ronchi lens test, the Fourier transformation of gratings and imaging of test pictures. The results are presented. Author (GRA)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N74-14388# Ruhr Univ., Bochum (West Germany).
MICROWAVE DELAY LINES AS DETECTOR FOR PROVING ELECTRON SPIN-NUCLEAR SPIN-DOUBLE RESONANCE Ph.D. Thesis [MIKROWELLENVERZOEGERUNGSLEITUNGEN ALS DETEKTOR ZUM NACHWEIS VON ELEKTRONENSPIN- KERNSPINDOPPELRESONANZEN]
Klaus-Dieter Schmalbein 1972 155 p refs In GERMAN
Avail: NTIS HC $9.75

An apparatus is reported for combined measurements of electron paramagnetic- and nuclear magnetic-resonances in liquids with only microsecond relaxation times. Its digitalized helix measuring head contains resonance circuits as well as a part of the impedance control loop and is well insulated against high frequency interference. High frequency/amplitude modulation provides a means of comparing spectral line intensities in liquid samples with relaxation times up to 4 times 10 to the minus seven power. Transl. by G.G.

N74-14389# National Bureau of Standards, Boulder, Colo. Lab. Astrophysics Div.
BIBLIOGRAPHY OF ION-MOLECULE REACTION RATE DATA: JANUARY 1950 - OCTOBER 1971
George A. Sinnott Oct. 1973 74 p refs
(NBS-SP-381) Avail: SOD HC $1.00 as C13.10.381

A bibliography is presented of papers in the open literature that contain original experimental data on ion-molecule reaction rates or cross sections. Positive and negative ion-molecule and ion-ion reactions are included but not electron impact processes. For papers to be included, the reactants must have been identified and data for kinetic energies below 10 electron volts must have been presented. Author

N74-14390# RAND Corp., Santa Monica, Calif.
THE MOTION OF A PARTICLE IN ORBIT AROUND A GROWING MASS
S. H. Dole Aug. 1973 3 p
(P-5069) Avail: NTIS HC $3.00

The orbital eccentricity of a particle in orbit about a body that is accumulating mass by accretion is discussed. A computer program was developed for iterative solution of Kepler's equation in which the position of a particle in orbit around a central mass and its orbital elements could be followed while small discrete mass additions to the central body were made at regular time intervals. The data obtained from the computer runs is tabulated for specified orbital parameters. It is concluded that the orbital eccentricity of a particle in orbit around a gradually growing mass does not change significantly with time. Author

N74-14391# Commissariat a l'Energie Atomique, Saclay (France). Centre D'Etudes Nucleaires.
[NUCLEAR PHYSICS STUDIES IN THE 1-GeV PROTON RANGE] Annual Progress Report, 15 Oct. 1971 - 30 Sep. 1972
1973 273 p refs In FRENCH
(CEA-N-1600) Avail: NTIS

The main features of the SPES I facility, devoted to nuclear physics studies in the 1-GeV proton range, are described. Results show an energy resolution of 130 keV for the scattering of 1.04-GeV protons by Ni-58 and the ability to determine angular distributions with an angular resolution equal to 6 mrd or better. Author (NSA)

N74-14392# California Univ., Berkeley. Lawrence Berkeley Lab.
NUCLEAR CHEMISTRY Annual Report, 1972
D. L. Hendrie, ed., C. F. Tsang, ed., and A. Zalkin, ed. May 1973 446 p refs
(Contract W-7405-eng-48)
(LBL-1666) Avail: NTIS

Research project reports on nuclear chemistry are presented. The subjects discussed are: (1) physics of the nucleus, (2) nuclear spectroscopy, radioactivity, and fission, (3) nuclear reactions and scattering, (4) nuclear theory, (5) photoelectron spectroscopy, (6) atomic and molecular spectrocopy, (7) X-ray crystallography, and (8) applications of activation analysis methods. Author

N74-14393# Oak Ridge National Lab., Tenn.
PROGRESS IN THE DOSIMETRIC APPLICATIONS OF EXOELECTRON EMISSION
K. Becker 1973 18 p refs Presented at 4th Intern. Symp. on Exoelectron Emission and Dosimetry, Liblice, Czechoslovakia, 1 Oct. 1973 Sponsored by AEC
(Conf-731008-2) Avail: NTIS HC $3.00

Exoelectron phenomena are used currently as a research tool in solid state physics, to detect structural damage in metals, and in radiation dosimetry. Progress in this latter field during the last three years is reviewed briefly. It includes some work on optical stimulation, but mostly on thermal stimulation techniques. The search for new material has centered around metal oxides (BeO, Al2O3, with and without activators) and mixtures of oxides including ZnO, SiO2, TiO2 and BaO. Closed GM-tube TSEE detectors have been developed, but bare discs of ceramic BeO:Si continue to be the most popular material. In the instrumentation field, the counter characteristics are now better understood, and improved counters have been designed. Ionization chambers have been employed successfully in high dose level readers. Author (NSA)

N74-14394# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
VIBRATIONAL EXCITATION OF MOLECULES VIA SHAPE RESONANCES
George J. Schultz 1973 24 p refs
(Contract N00014-67-A-0097-0025)
(AD-767059) Avail: NTIS CSCL 07/4

The paper presents a survey of the progress made in understanding vibrational excitation of molecules by electron impact, with special emphasis on new results obtained in the past year. It is shown that the properties of the shape resonance in the specific molecules determine the behavior of the vibrational cross sections at low energies. Thus the lifetime and the energy of the resonances are determining factors. Examples are given for N2, O2, and CO2. For the case of N2 the cross sections to high vibrational states, up to v = 10 are discussed for the energy range 2-4 eV. For O2, we present data in the energy range 0-14 eV and for CO2, new data for the 3.8 eV resonance are shown. (Modified author abstract) GRA

N74-14486* Bell Telephone Labs., Inc., New York.
POSITRONIUM FORMATION RED SHIFT OF THE 511-keV ANNIHILATION LINE
M. Leventhal *In* NASA. Goddard Space Flight Center Gamma-Rays Astrophys. 1973 p 291-296 refs (For availability see N74-14465 05-29)
CSCL 20H

N74-14492* Yale Univ., New Haven, Conn.
ANTIMATTER IN THE UNIVERSE
Gary Stigman *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 361-366 refs (For availability see N74-14465 05-29)
CSCL 20H

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N74-14395 Pennsylvania Univ., Philadelphia.
CONTINUUM THEORY OF ELECTROSTATIC PROBES IN A MODERATELY IONIZED PLASMA Ph.D. Thesis
Michael S. Barad 1973 216 p
Avail: Univ. Microfilms Order No. 73-24113

Continuum electrostatic probe theory is developed for a collision-dominated plasma in which the ratio of charge-charge to charge-neutral collision frequencies may range between zero and unity. The former limit corresponds to the usual weakly ionized condition of earlier probe analyses, while for non-zero values of this ratio transport coefficients must be assumed to vary with position in the plasma. An examination is made of the dependence of the collision frequency ratio on ionization fraction at various temperatures, and it is found that for many

cases of practical interest it is necessary to include charge-charge interactions in the formulation. The governing equations are nonlinear and highly coupled. Plasma property profiles in the vicinity of the probe, for a number of values of the collision frequency ratio and a wide range of probe potentials, are plotted and investigated. The effects of including variable transport coefficients in the formulation are discussed. Dissert. Abstr.

N74-14396 Polytechnic Inst. of Brooklyn, N.Y.
INSTABILITY AND DYNAMIC SUPPRESSION IN A MAGNETO-PLASMA Ph.D. Thesis
Richard Kristal 1973 138 p
Avail: Univ. Microfilms Order No. 73-24775

Measurements have been made of the equilibrium and stability characteristics of a hollow cathode arc generated plasma in a magnetic field. A method of dynamic suppression using open loop electron temperature modulation has been used to achieve up to 6 db of mode suppression in the unstable regime. Measurement was made of the instability radial profile, azimuthal and longitudinal phase to determine the wave dispersion characteristics. Special probe and optical facilities were designed for this purpose. Information is also provided on ion temperature and rotational drift, which are important for determining the quiescent cpnditions leading to instability. For these measurements a scanning Fabry-Perot interferometer and optical system has been designed to determine Doppler broadening and line shift. Also precise double probe measurements have been made to determine density and electron temperature profiles.
Dissert. Abstr.

N74-14397# Technischen Universitaet, Munich (West Germany).
EXPERIMENTAL DETERMINATION OF THE ENERGY TRANSPORT IN CYLINDRICAL NITROGEN ARCS AT VARIABLE TUBE DIAMETER Ph.D. Thesis [EXPERIMENTELLE BESTIMMUNG DES ENERGIE-TRANSPORTS IN ZYLINDRISCHEN N2-BOEGEN MIT VARIATION DES ROHRDURCHMESSERS]
Karl August Ernst 1972 69 p refs In GERMAN
Avail: NTIS HC $5.50

Measurements of field density/current density and of volume radiation/current density characteristics on stationary nitrogen cascade arcs in cylindrical palsmas are used to determine electrical conductivity, thermal conductivity, radiative emission and absorption energies for different plasma radii. Energy transport values are obtained by applying Ohm's law for interpolating gradient current parameters of individual geometry arc flows.
Transl. by G.G.

N74-14398# Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany).
SLAB MODELS FOR CLASSICAL DIFFUSION IN THE BELT PINCH
Glenn Bateman Mar. 1973 49 p refs
(IPP-1/131) Avail: AEC Depository Libraries HC $4.50

Classical diffusion is considered as a time-dependent and self-consistent problem for a free-boundary plasma in the plane slab and cylindrical slap geometries. These conditions approximate the Belt Pinch experiment. It is found that the instantaneous diffusion rate changes rapidly as the plasma spreads and the fields decay. There is a succession of at least four physical phenomena which can dominate under different conditions. The poloidal electric field decays rapidly during an initial, finite-beta transient stage. The pinch effect induced by the toroidal electric field may impede diffusion for an intermediate time span. After the pinch effects become negligible, Spitzer diffusion induces a pressure decay which is algebraic with time and a poloidal B-field decay which is exponential with time. The Pfirsch-Schlueter effect enhances this diffusion only late in the discharge after the plasma has spread out and the rotational transform has decayed. NSA

N74-14399# Kernforschungsanlage, Juelich (West Germany).
INVESTIGATION OF PLASMA TURBULENCE IN A TRAVELING-WAVE ACCELERATOR BY LASER SCATTERING MEASUREMENTS
K. H. Finken Dec. 1972 102 p refs In GERMAN
(JUL-907-PP) Avail: AEC Depository Libraries HC $7.25

In order to examine the influence of plasma turbulence on plasma acceleration, the interaction between a wave of high amplitude and a plasma in a pulsed operated traveling-wave experiment was investigated. Besides conventional techniques, the 90 deg laser light scattering is mainly used for the diagnostics. The outer alternating field creates a cylindrically symmetrical compression Alfven wave in the magnetized plasma. By varying the magnetic field and the density, radial eigenmodes of this wave can be excited in which 80% of the outer-wave energy in the plasma is dissipated. A simplified MHD model is derived to describe the plasma state. From a comparison between measured values and results of the model calculation, it can be seen that a greater dissipation of energy occurs due to turbulent effects when the drift rate between electrons and ions, caused by electric currents, exceeds the ion resonance velocity threshold. NSA

N74-14400# Technische Univ., Berlin (West Germany).
INVESTIGATION OF THE ACCELERATOR NOZZLE IN THE MHD-CONDENSER PROCESS AND COMPARISON OF DIFFERENT PROCESS OPERATIONS
J. Freund Jun. 1972 182 p refs In GERMAN; ENGLISH summary
(SFB-MHD-8) Avail: AEC Depository Libraries HC $11.25

Some processes were investigated for the one component condenser cycle of magnetohydrodynamic energy conversion with potassium as the working medium. These included two different ways of liquid preheating and a third method with an additional pre-separation of vapor. A main item was the investigation of the nozzle. Wall friction, acceleration of two groups of droplets with different mean diameter, droplet disintegration, and heat removal from the expanding two phase stream were taken into account. The results showed decreasing nozzle efficiency due to increasing length and heat removal. The nozzle performance strongly determined the efficiency of the cycle without regard of the generator. Its value increased with longer nozzles. It reaches maximum values for inlet vapor qualities of about 5 to 10%. The values of different losses are estimated.
Author (NSA)

N74-14401# Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany).
RELATIVISTIC THEORY OF ELECTROMAGNETIC SUSCEPTIBILITY AND ITS APPLICATION TO PLASMAS
R. A. OSullivan and H. Derfler Apr. 1973 47 p refs
(IPP-4-55) Avail: AEC Depository Libraries HC $4.50

Covariant dispersive relations are developed for an arbitrary, anisotropic, dispersive, dissipative medium, allowing for relaxation phenomena. Covariant wave dispersion relation is derived. The susceptibility tensor of order four is given explicitly for a Vlasov plasma with arbitrary velocity distribution and nonzero dc electric field. It is then shown how to determine the constitutive relation explicitly from the moment of the single-particle current, without using the Vlasov equation. The familiar dielectric tensor is obtained as a special case. NSA

N74-14402# Dartmouth Coll., Hanover, N.H. Dept. of Physics and Astronomy.
OBSERVATION OF THE BEAM-PLASMA INTERACTION BELOW THRESHOLD
J. R. Conrad, C. J. Diaz, and J. E. Walsh 1972 31 p refs
(Contract AT(11-1)-3632)
(COO-3632-8) Avail: NTIS HC $3.75

The wave spectrum of longitudinal electrostatic fluctuations of a beam-plasma system was studied in the regime below the threshold for exponentially growing waves. The observed wave spectrum consists of a series of triplets, one set for each natural mode of the magnetized, cylindrical, axially bounded plasma column. The line shape and intensity of the triples are in good agreement with a simple theory based on the linearized dispersion relation.
Author (NSA)

N74-14403# Colorado Univ., Boulder.
NONLINEAR PHENOMENA IN COLLISIONLESS PLASMA Progress Report, 1 Sep. 1972 - 31 Aug. 1973
R. E. Aamodt, R. L. Berger, J. M. Hoffman, and E. A. Williams 1973 47 p refs
(Contract AT(11-1)-2081)
(COO-2081-12) Avail: NTIS HC $4.50

The primary effort was directed at understanding basic

nonlinear mechanisms of importance to the heating and containment of collisionless plasmas. Emphasis was placed on those processes most likely to be important in open-ended systems; in addition, parametric-instability problems associated with the laser-pellet implosion technique were examined. Also several linear phenomena of potential relevance to the fusion program were studied associated with RF heating and the coupling of radiation and electron beams into dense plasmas.
Author (NSA)

N74-14404# Los Alamos Scientific Lab., N.Mex.
LASER-INDUCED INSTABILITIES AND ANOMALOUS ABSORPTION IN DENSE PLASMAS
D. F. DuBois 1973 25 p refs Presented at 3d Workshop on Laser Interaction and Related Plasma Phenomena, Troy, N. Y., 13-17 Aug. 1973 Submitted for publication
(Contracts W-7405-eng-36; F44620-73-C-0003)
(LA-UR-73-1123; Conf-730836-1) Avail: NTIS HC $3.25
The nonlinear and linear theory of parametric instabilities in laser-produced plasmas is given for both the homogeneous and inhomogeneous cases.
NSA

N74-14405# Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes Nucleaires.
INTERACTION OF A LASER-PRODUCED PLASMA WITH AN INTENSE MAGNETIC FIELD
Denis Colombant, Nguyen Trong Thuc, and Jacques Raguideau Aug. 1973 52 p refs In FRENCH
(CEA-R-4445) Avail: AEC Depository Libraries HC $4.75
The expansion of a plasma produced from a solid pellet in a magnetic field and then the compression of an already produced plasma by a magnetic field are studied. In the first case, an absorption model has been introduced which takes into account the main features of much more sophisticated models without, however, setting any constraints on the computation time. The mathematical model as well as the numerical method used are detailed. Results are then presented for both problems considered. The limits of the different models are outlined in a final part.
Author (NSA)

N74-14406# University of Southern Calif., Los Angeles. Dept. of Physics.
THE LOWERING OF THE IONIZATION POTENTIAL OF HYDROGEN AND CARBON IN A PLASMA
Santosh K. Srivastava and G. L. Weissler 1 Oct. 1973 21 p refs
(Contract N00014-67-A-0269-0014)
(AD-767782; USC-VacUV-132) Avail: NTIS CSCL 07/4
The lowering of the ionization potentials of hydrogen and carbon atoms immersed in a high temperature and high density thermal plasma generated in a wall stabilized arc was estimated from the advance or shift of their respective series limits in the vacuum ultraviolet region of the spectrum for different electron densities and temperatures. Results show a close agreement with those theoretical calculations in which the effects of both microfield and polarization terms are added. However, electron densities are lower by about two orders of magnitude than the critical electron densities required by theory for the inclusion of the microfield term. The question of validity of a critical electron density is discussed.
Author (GRA)

N74-14407# Systems Science and Software, La Jolla, Calif.
CAPO: A COMPUTER CODE FOR CALCULATING EQUATION OF STATE/OPACITY INFORMATION
Ira Katz, Robert Vik, and James Harvey Oct. 1973 16 p refs
(Contract DNA001-73-C-0061)
(AD-768043; SSS-R-73-1825; DNA-3191T) Avail: NTIS CSCL 07/4
The availability and applicability of CAPO, a computer code to calculate plasma equation of state and opacity information, is described. A calculation of a 50 eV iron spectrum is included as an example of CAPO's capabilities.
Author (GRA)

N74-14408# Office of Naval Research, London (England).
MHD FOR POWER GENERATION: THE VIEW OF A CHOSEN FEW
David F. Dyer 20 Apr. 1973 11 p
(AD-760342; ONRL-C-10-73) Avail: NTIS CSCL 20/9
A report of the ninth meeting of the international liaison group on magnetohydrodynamics power generation and the MHD closed cycle specialist meeting held in Geneva is given. The following topics are discussed various concepts proposed for MHD power generation the role of programs in various countries technology problems to be overcome in producing viable MHD power generation systems meetings and publications concerned with MHD for power generation.
Author (GRA)

N74-14409# Cornell Univ., Ithaca, N.Y.
FUNDAMENTAL STUDIES ON TURBULENT HEATING OF A FUSION PLASMA Annual Summary Report, 1 Jul. 1972 - 30 Jun. 1973
Charles B. Wharton 30 Jun. 1973 23 p refs
(Contract N00014-67-A-0077-0022)
(AD-768062) Avail: NTIS CSCL 20/9
During the past year the investigation has continued of the scaling laws of turbulent heating and on optimizing the experiment as a pulsed plasma heating device. Three main conclusions have been reached from these investigations: The plasma resistivity is anomalously large during turbulent heating, approaching the Buneman value normally associated with the electron 2-stream instability, yet the observed turbulent spectrum is more appropriate for ion acoustic waves; the ion energy distribution is non-Maxwellian, but nearly isotropic. The ions have a small drift in one direction, and a high energy tail in the opposite (electron drift) direction; the turbulent heating often limits itself before the peak of the current is reached.
GRA

N74-14410# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ELECTROMAGNETIC PULSE PROPAGATION IN BOUNDED PLASMAS, ANISOTROPIC PLASMAS, AND LOSSY PLASMAS M.S. Thesis
John A. Justice Jun. 1973 117 p refs
(AD-768350; GEP/PH/73-12) Avail: NTIS CSCL 20/14
The dispersion of electromagnetic pulses in plasmas is considered. Maxwell's equations are used to determine the wave equation in the Fourier transform domain. Thus, the fields in the time domain are determined by inverse Fourier transformations. Asymptotic solutions for the fields are obtained via the saddlepoint method of integration. The investigation considers three different plasma models. The first model is a homogeneous, isotropic, plasma slab with infinitesimal boundaries. The reflection and transmission coefficients are found to be frequency dependent. When an air-plasma-air problem is considered, the transmission coefficient is almost one and the boundary effects are thus negligible. The second model is a homogeneous, anisotropic plasma where propagation along magnetic field lines is considered. Responses to both double exponential and delta function initial pulse shapes are obtained. The results show significant transient Faraday rotation, even for weak magnetic fields. The third model is a homogeneous, isotropic, lossy plasma. (Modified author abstract)
GRA

N74-14411# Naval Postgraduate School, Monterey, Calif.
THE PRESSURE DEPENDENCE OF SPONTANEOUS MAGNETIC FIELDS IN LASER PRODUCED PLASMAS Ph.D. Thesis
Ronald Stanley Bird Jun. 1973 147 p refs
(AD-767683) Avail: NTIS CSCL 20/9
A plasma has been produced by irradiation of an aluminum slab with a 6.6 joule, 22 nanosecond (10 to the 10th power watt/sq cm) pulse of 1.06 micrometer radiation. Magnetic fields were observed to arise spontaneously when the laser-produced plasma was formed. The space and time behavior of the spontaneous magnetic fields and their relationship to the plasma density profile for expansion into various background pressures of H2, He, N2 and Ar was investigated using magnetic and electrostatic (double) probes. The magnitude and direction of the magnetic fields was found to depend on the background gas pressure. The generation of spontaneous magnetic fields at the front of the expanding laser plasma was observed long after laser irradiation ceased. These fields were axially symmetric and in a direction opposite to the initial field direction. Reverse fields were observed only above a critical background gas pressure. Magnetic fields were also observed to arise when a laser plasma impinged on a glass plate. The observed increase of

the magnitude of the initial spontaneous magnetic fields is interpreted as arising from the momentum interaction between the expanding laser plasma and the pre-ionized ambient background plasma. The reverse field is attributed to the development of an axial electron temperature gradient at the plasma front due to snowplowing of the ambient plasma.
Author (GRA)

N74-14412# Naval Research Lab., Washington, D.C.
K-SHELL LINE RADIATION FROM LASER PRODUCED ALUMINUM PLASMAS Interim Report
K. Whitney, J. Davis, and E. Oran Jun. 1973 91 p refs
(DNA Proj. NWER-PF-001)
(AD-767923; NRL-MR-2644) Avail: NTIS CSCL 20/9

Two rate equation models are developed to describe the emission of K-line radiation from laser-produced aluminum plasmas. In the first model, the temperature of the electrons is a freely variable quantity; whereas, in the second model, it is computed from a kinetic energy equation in which phenomenological terms representing thermal conduction and laser energy absorption are introduced. The latter model predicts X-ray emission from a hot-spot of plasma in close agreement with observations from an experiment initiated by focusing 1.9 J of neodymium radiation in a 1/4 nanosecond pulse onto an aluminum target. Computer solutions to the rate equation model are obtained for a number of different prescribed time variations of the electron temperature. These solutions are compared to a similar set of solutions to a coronal model. It is found that these two sets of solutions differ significantly whenever the electron temperature varies rapidly over subnanosecond periods and the aluminum plasma has not been overheated and driven to the state of total ionization. Author (GRA)

N74-14413# Air Force Academy, Colo.
NONLINEAR ABSORPTION AND HEATING OF DENSE PLASMAS Technical Report, Jun. - Aug. 1973
Norman F. Roderick Sep. 1973 49 p refs
(AD-768341; DFAN-TR-73-7) Avail: NTIS CSCL 20/9

Absorption of laser radiation by dense plasmas is studied using the model of Dubois, Goldman, and McKinnis for saturation of the parametric decay instability. The basic model contains both linear and nonlinear absorption mechanisms. The nonlinear mechanism includes spectrum broadening, Landau damping, and mode coupling. Modifications have been made to investigate various density profiles and to include the increase in threshold intensity due to the presence of the nonuniform plasma. Physical parameters investigated are those characterizing an exploding aluminum wire plasma and the pinch region of a dense plasma focus both illuminated by a high intensity CO2 laser. Results indicate the previously noted increases in absorption due to the inclusion of the nonlinear saturation mechanism. The previously obtained increases in absorption with increasing density scale height and decreasing temperatures are also recovered. The former indicates end on illumination of the pinch region as the most favorable for heating. The general density results also show the absorption to be a strong function of the shape of the density profile. (Modified author abstract) GRA

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N74-14414 Yale Univ., New Haven, Conn.
ELECTRON SPECTROSCOPY AND ADSORPTION ON SEMICONDUCTOR SURFACES Ph.D. Thesis
Mohammed Saleh Jazzar 1973 117 p
Avail: Univ. Microfilms Order No. 73-19026

A series of experiments is presented on the adsorption properties of semiconductor surfaces. Data cover: (1) photoemission measurements of cleaved (110) surfaces of n- and p-type GaSd electronic properties, (2) photoemission analysis of cleaved cesiated Si(111) snd GaSd(110) surfaces, and (3) LEED, Auger, and photoemission examination of cesiated semiconductor surfaces. Results show that the sticking probability of cesium on semiconductors is found to be about 0.2 at room temperature, multilayers of cesium can only be formed at cold substrates, and at room temperature only submonolayers of cesium are bound strongly enough to the surface. Cesium does not drive the n-type and thus it is not adsorbed in ionic form. The concept of orbital electronegativities is used to explain the lowering of the work function of cesiated semiconductor surfaces. Dissert. Abstr.

N74-14415 Texas A&M Univ., College Station.
MINIMIZATION OF DISLOCATION CREATION AND INTERFACE STRESSES DURING THE THERMAL OXIDATION OF SILICON Ph.D. Thesis
Surinder Mohan Coklaney 1973 78 p
Avail: Univ. Microfilms Order No. 73-21663

Dislocation creation in single crystal silicon slices due to thermal oxidation is considered. The presence of thermally induced dislocations was found to influence the capacitance vs. bias voltage characteristic of a MOS capacitor using a thermally grown silicon dioxide layer as the dielectric. The MOS capacitors fabricated on a dislocated region of silicon exhibit low frequency characteristic when measurements are made at high frequency. A stress model was developed to calculate the average stress associated with the bending of silicon slices when the oxide from one side is etched off. The coefficient of linear thermal expansion for silicon dioxide grown in steam and wet O2 ambients is also calculated. Based upon the experimental information obtained, optimum conditions for thermal oxidation of single crystal silicon slices that result in minimum dislocation density and low interface stresses are proposed and discussed. Thermal oxidation in a wet O2 ambient was found suitable. Dissert. Abstr.

N74-14416 Washington Univ., St. Louis, Mo.
A STUDY OF THE TECHNOLOGICAL FEASIBILITY OF A PROPOSED SEMICONDUCTOR RADIATION DETECTOR Ph.D. Thesis
Hosea Reid Vann 1973 153 p
Avail: Univ. Microfilms Order No. 73-24927

In the proposed semiconductor detector, the active region has an electric field applied which is orders of magnitude below that of conventional detectors. The minority carriers which result from the interaction of radiation with the semiconductor are drifted by this electric field to a region near the depletion layer formed by the base-collector junction of a transistor structure which is an integral part of the detector. Those carriers which are captured by the electric field of the depletion layer are swept into the transistor base region, forming a base current which is amplified. An analytical design procedure is developed and a set of parameters proposed which, if met, should assure proper device operation. A technology is then developed which is used to make devices in silicon whose parameters meet or exceed those proposed. Dissert. Abstr.

N74-14417 Pennsylvania State Univ., University Park.
THE ROLE OF INTERNAL BOUNDARIES UPON THE DIELECTRIC PROPERTIES OF POLYCRYSTALLINE FERROELECTRIC MATERIALS PH.D. Thesis
David Alan Payne 1973 334 p
Avail: Univ. Microfilms Order No. 73-24030

Following an introduction to ferroelectric materials and high K ceramics an approach is developed by which polycrystalline properties may be related to single crystal values through appropriate averaging procedures. Dielectric mixing rules are reviewed (including dispersion relations), and average properties calculated for various modes of phase mixing within polycrystalline ensembles. The importance of electrical and mechanical boundary conditions surrounding each phase is discussed, especially with respect to their influence on overall average properties; and the dielectric response of various technical ceramics described in terms of their equivalent electric circuits. Diphasic mixing is treated in more detail for the physically relevant case pertinent to high K ceramics: where the minor phase is continuously connected, separating the major phase into discrete localized volumes (viz., grains). Dissert. Abstr.

N74-14418 Alfred Univ., N.Y.
THE STRUCTURE AND OPTICAL PROPERTIES OF EVAPORATED BISMUTH TRIOXIDE THIN FILMS Ph.D. Thesis

John William Medernach 1973 139 p
Avail: Univ. Microfilms Order No. 73-22963

An investigation was conducted in view of the small amount of published information on the stoichiometry; structure, and optical and electronic properties of Bi2O3 thin films. The study correlates the structure and optical properties of the Bi2O3 thin films with their stoichiometry. Bismuth trioxide thin films were prepared by vacuum evaporation from a platinum boat source with the evaporation rate varied from 1 to 25A/sec. The structure investigation was made using conventional electron and X-ray diffraction methods. The optical-parameters were calculated from transmittance and reflectance measurements. Computer calculated powder diffraction patterns were made for all reported forms of Bi2O3. This data then was compared to the experimental values obtained in the investigation. Dissert. Abstr.

N74-14419 Washington Univ., Seattle.
ACOUSTOELECTRIC DOMAIN DYNAMICS AND ELECTROLUMINESCENCE ASSOCIATED WITH PROPAGATING DOMAINS Ph.D. Thesis
Walter George Macomber 1973 106 p
Avail: Univ. Microfilms Order No. 73-22588

Theory and experiments related to propagating acoustoelectric domains in semiconducting II-VI compounds are briefly reviewed. The instantaneous current voltage characteristic (Delta I- Delta V curve) of the propagating domain is obtained by a double pulse technique. An upward bend in the curve occurs at pulse technique. An upward bend in the curve occurs at the voltage applied to the sample before the curve is measured. The bend of the curve is interpreted as an important factor in the dynamic processes which determine domain shape and amplitude. The excess voltage pulse used to measure the curve causes a short < 100ns) burst of band edge electroluminescence. Self-illuminated photographs of the propagating domain made using the short bursts of light show the domains to be approximately 0.5 mm wide. An analytic solution of the current density equation for a single frequency acoustic wave is obtained by assuming a piecewise linear potential. The solution is applicable over the whole range of acoustic energy and electric fields which occur in acoustoelectric phenomena. Dissert. Abstr.

N74-14420 Maryland Univ., College Park.
MULTI-PHOTON CONDUCTIVITY IN SEMICONDUCTORS AND MEASUREMENT OF PICOSECOND PULSEWIDTH Ph.D Thesis
Subramania Jayaraman 1973 161 p
Avail: Univ. Microfilms Order No. 73-23729

Two photon conductivity in GaAs, CdS5-Se5 and three photon conductivity in CdS using Q-switched and mode-locked Nd:glass laser pulses were examined. The two photon conductivity in GaAs (low resistivity and high resistivity samples) was studied with Q-switched and mode-locked Nd:glass laser pulses. The two photon conductivity in GaAs was found to exhibit a square law dependence on intensity over a very narrow region of laser intensity, and this was found consistent with the thickness of the crystal and the measured two photon absorption coefficient in GaAs. Two photon conductivity in CdS5-Se5 with the use of mode-locked Nd:glass laser pulses displayed a square law region over a more dynamic range of incident laser intensities and the photoconductivity correlation gave a contrast ratio of approximately 2.4 and a half width of approximately 8-10 psecs. Dissert. Abstr.

N74-14421 Cincinnati Univ., Ohio.
INTERACTIONS OF VORTEX LATTICE MOTION IN NIOBIUM, A TYPE-TWO SUPERCONDUCTOR Ph.D. Thesis
Frank Wen Bao 1973 104 p
Avail: Univ. Microfilms Order No. 73-24837

An attempt was made to study normal flux lattice interactions with pinning wells and dissipative mechanisms. In order to get internal consistency, the experiment was performed in all three frequency ranges of interest; dc, audio frequency (2000hz-12,000hz), and radiofrequency (.1mc-110mc). The most fundamental are dc measurements which yielded information of flow resistivity, pinning constant alpha=2780 gaussampere, and threshold field for fluxoid entry of H=750 gauss. The audio transmission measurements have proven to be a very useful means for studying flux motion within the pinning wells. This technique is very sensitive to dc transport currents. DC flux flow data was used to calculated the depinning frequency and the results were found to be in agreement with rf network analyzer measurements. This was probably due to the internal consistency offered by the use of the same strip of niobium used throughout the experiment. An alternate and physically relevant definition of the depinning frequency was developed. Dissert. Abstr.

N74-14422*# Kanner (Leo) Associates, Redwood City, Calif.
SOME ELECTRON STRUCTURE CHARACTERISTICS OF W-Re SOLID SOLUTIONS
S. S. Budagovskiy, V. N. Bykov, M. I. Gavrilyuk, and V. N. Podyachev Washington NASA Dec. 1973 20 p refs Transl. into ENGLISH from Metallofiz. (USSR), no. 44, 1973 p 57-67 (Contract NASw-2481)
(NASA-TT-F-15214) Avail: NTIS HC $3.00 CSCL 20L

For solid solutions with a bcc lattice in W-Re alloys, measurement results of various parameters are reviewed. These parameters include the electrical resistance, Hall effect, reluctance, crystal lattice parameter, angular annihilation-photon correlation, and magnetic susceptibility. The possible causes of some of the anomalies exhibited by these data are discussed. Author

N74-14423*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF EPITAXIAL BACK SURFACE FIELD CELLS
Henry W. Brandhorst, Jr., Cosmo R. Baraona, and Clifford K. Swartz 1973 12 p refs Presented at the 10th Photovoltaic Specialists Conf., Palo Alto, Calif., 13-15 Nov. 1973; sponsored by IEEE
(NASA-TM-X-71487; E-7820) Avail: NTIS HC $3.00 CSCL 20B

Epitaxial back surface field structures were formed by depositing a 10 micron thick 10 Omega-cm epitaxial silicon layer onto substrates with resistivities of 0.01, 0.1, 1.0 and 10 Omega-cm. A correlation between cell open-circuit voltage and substrate resistivity was observed and was compared to theory. The cells were also irradiated with 1 MeV electrons to a fluence of 5 X 10 to the 15th power e/cm2. The decrease of cell open-circuit voltage was in excellent agreement with theoretical predictions and the measured short circuit currents were within 2% of the prediction. Calculations are presented of optimum cell performance as functions of epitaxial layer thickness, radiation fluence and substrate diffusion length. Author

N74-14424# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
TECHNIQUES FOR THE MEASUREMENT OF THE SEMICONDUCTOR PROPERTIES OF THERMOELECTRIC MATERIALS
D. J. Ryden May 1973 28 p refs
(AERE-R-6996) Avail: AEC Depository Libraries HC $3.50; HMSO 50p; PH; $2.15

Semiconductors used in thermoelectric devices have properties lying between those of metals and the more usual electronic device semiconductors. Techniques that may be used to measure resistivity, the Seebeck coefficient, the thermoelectric figure of merit, the thermal conductivity, and the Hall coefficient are discussed. An outline of the various measurement methods is given, and those aspects that experience has shown to be a problem are discussed. The pieces of apparatus used in this laboratory are described, and estimates of the accuracy that may be expected are given. Author (NSA)

N74-14425# Central Research Inst. for Physics, Budapest (Hungary).
ELECTRIC-FIELD-INDUCED INSTABILITIES IN NEMATIC LIQUID CRYSTALS
L. Bata, A. Buka, and I. Janossey 1973 10 p refs
(KFKI-73-32) Avail: AEC Depository Libraries HC $3.00

Instabilities arising when a static or alternating electric field is applied to a nematic liquid crystal cell are discussed. The threshold voltage for including instability is presented as a function of the frequency. Regular structures observed at static and alternating fields are described in detail. Some observations

associated with development of turbulence are also reported.
Author (NSA)

N74-14426# California Univ., Berkeley. Lawrence Berkeley Lab.
SOLID STATE PHYSICS
K. M. Crowe Jun. 1973 20 p refs Presented at 5th Intern. Conf. on High-Energy Phys. and Nucl. Structure, Uppsala, 18 Jun. 1973
(Contract W-7405-eng-48)
(LBL-2104; Conf-730642-9) Avail: NTIS HC $3.00

A review of muon + precession experiments is presented. The behavior of the spin of the muon as it interacts in different solids and liquids is discussed, as is muonium formation, fast depolarization, and slower relaxation solids and solutions with various chemical and magnetic ions. The interpretation of muonium hyperfine spectra in germanium and silicon, as well as the recently observed anomalous muon (+) precession in silicon, are presented. The use of muons to probe internal magnetic fields in ferromagnets is also reported. Author (NSA)

N74-14427# Perkin-Elmer Corp., Wilton, Conn.
MOLECULAR BEAM EPITAXY OF II-VI COMPOUND WAVEGUIDES Quarterly Technical Report, 1 Jul. - 30 Sep. 1973
Donald L. Smith 30 Sep. 1973 25 p refs
(Contract N00014-73-C-0280; ARPA Order 2327)
(AD-768283; PE-11719) Avail: NTIS CSCL 20/2

Optical waveguide growth is being pursued using molecular beam epitaxy, a closely-controlled form of vacuum evaporation, under ultra-high vacuum. Zn and Te2 vapor pressures over the elements and over ZnTe have been measured and correlated with film growth behaviour. Optically-clear, mirror-smooth, monocrystalline, 1 micron thick films of ZnTe have been grown at 1 micron/hour on 350C CaF2(111) substrates using separate elemental sources of 6-nines pure Zn and Te. Film stoichiometery was insensitive to incident Zn/Te flux ratio. Films were polycrystalline at 450C and ceased to deposit at 500C. Films were grown from a single 5-nines pure ZnTe source of inferior quality. Single-crystal CdSe(0001) substrates have been prepared by Br/MeOH polishing and ion bombardment. (Modified author abstract) GRA

N74-14428# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
A NOVEL PARAMETRIC NEGATIVE RESISTANCE EFFECT IN JOSEPHSON JUNCTIONS Report for 1 Jan. - 30 Jun. 1973
Helmut Kanter 29 Oct. 1973 19 p refs
(Contract F04701-73-C-0074)
(AD-768335; TR-0074(9230-02)-3; SAMSO-TR-73-302) Avail: NTIS CSCL 20/12

The negative resistance effect recently predicted for current controlled highly damped Josephson junctions is experimentally demonstrated at a frequency of 9 GHz. Characteristically, the pump (or Josephson) frequency is smaller than the amplified one and the pump mechanism is effective over a broad range of frequencies in contrast to the conventional parametric negative resistance effect where the pump frequency exceeds that of signal and idler and where the frequency of operation is limited to a narrow range. The broadband feature renders operation uncritical to tuning and bias voltage fluctuations. The fact that the junction is the element of lowest impedance in the circuit alleviates to a degree the matching problem generally encountered with Josephson contacts. Author (GRA)

N74-14429# Intelcom Rad Tech, San Diego, Calif.
IRRADIATION EFFECTS IN PbSnTe Annual Report, 1 Aug. 1972 - 31 Jul. 1973
Joseph F. Colwell, Barry A. Green, Howard W. Harper, Roland E. Leadon, and James A. Naber 17 Aug. 1973 75 p refs
(Contract N00014-73-C-0013)
(AD-768073; RT-8040-001) Avail: NTIS CSCL 20/12

The electrical properties of Pb(1-x)Sn(x)Te have been measured before and after irradiation and during isochronal annealing after irradiation for samples with a nominal value of x = 0.2 and different initial hole densities. For two samples that were initially degenerate at 78K, the hole density decreased with electron and fission neutron irradiation. For a zinc-diffused sample that was initially nondegenerate at 78K, electron irradiation caused an increase in hole density. The heavily doped samples remained p-type over the full range of temperature measurements, whereas the lower-density sample converted to n-type at higher temperatures. Possible models are proposed to explain these results. Theoretical calculations of lattice mobility have been made and are compared to the measured mobilities. The theoretical amount of radiation energy that goes into displacement damage in PbSnTe has been calculated for electrons of various energies and for a fission neutron spectrum. Author (GRA)

N74-14430# Intelcom Rad Tech, San Diego, Calif.
TRANSIENT RADIATION EFFECTS RESEARCH Final Report, 3 Apr. 1972 - 30 Jun. 1973
Joseph L. Azarewicz, Robert A. Berger, Joseph F. Colwell, Barry A. Green, and Terry M. Flanagan Jul. 1973 174 p refs
(Contract DAAG39-68-C-0060; HDL Proj. 23500)
(AD-768212; RT-8044-001; HDL-TR-0602) Avail: NTIS CSCL 20/12

The theory of displacement damage in semiconductors has been used to investigate the effect of neutron energy on damage curves and short-term annealing, to derive a curve of equivalent 1-MeV electron fluence for irradiation by protons, and to calculate the relative displacement damage produced in GaAs by electrons of various energies. The results of optical and electrical studies on GaAs irradiated at room temperature with 1- and 30-MeV electrons, together with postirradiation annealing data, are presented. Electron irradiation of high-purity n- and p-type silicon yielded information on the energy level of the donor and acceptor states of a defect assumed to be the isolated vacancy. The results are presented of investigations to determine the cross sections for capture of holes by negatively charged gold atoms in gold-doped n-type silicon. A study was initiated of the recombination lifetime at low temperature in specially doped silicon used for infrared detector fabrication, and preliminary results are presented. Development of a fast-time-resolution optical absorption apparatus has involved testing of materials for Cerenkov sources. Results of these studies are presented. Charge injection and storage release in two common capacitor materials, Mylar and Teflon, have been studied. The charge storage is dependent on the nature of this interface and, in some cases, on the bias temperature history. Author (GRA)

N74-14431# New South Wales Univ., Kensington (Australia).
ELECTRON PARAMAGNETIC RESONANCE STUDY OF GaAs SURFACES Annual Report, 1 Feb. 1972 - 31 Jan. 1973
D. Haneman Apr. 1973 17 p refs
(Grant DA-CRD-AFE-S92-544-71-G168; DA Proj. 1Z6-24201-D-466-03)
(AD-767752; ARDG(EE)-440-6) Avail: NTIS CSCL 20/12

The clean surfaces of GaAs single crystals are of considerable technological importance. When properly covered with cesium and oxygen, they display negative electron affinity, making them efficient photoemitters in the infrared. The general nature of the effect is understood in terms of general parameters such as work function, but not the details at the atomic level. These await a knowledge of the structure and electron properties of clean GaAs (110) surfaces. The present work is aimed at obtaining such an understanding, using electron paramagnetic resonance (EPR) techniques. The task of obtaining large single crystal cleavage surfaces in ultra high vacuum in the central portion of a microwave cavity, cooling them to low temperatures and obtaining sufficient signal to noise ratio from the relatively small surface area is an exacting one. The work of the last year, has been mainly devoted to developing the experimental techniques necessary to achieve this. (Modified author abstract) GRA

N74-14432# Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.
THE REFRACTIVE INDEX OF Pb(1-x)Sn(x)Te, Pb(1-y)Sn(y)Se, AND PbS(1-x)Se(x) AND THEORETICAL CALCULATIONS FOR Pb(1-x)Sn(x)Te AND Pb(1-y)Sn(y)Se 10.6 MICRON HETEROSTRUCTURE INJECTION LASERS M.S. Thesis
Walter George Opyd Jun. 1973 93 p refs
(AD-767677) Avail: NTIS CSCL 20/12

The refractive indices, n, in the fundamental absorption edge

regions of three alloy semiconductors, Pb(1-x)Sn(x)Te, Pb(1-y)Sn(y)Se, and PbS(1-x)Se(x), are investigated. Preliminary results of the refractive indices of PbS(1-x)Se(x) thin films are presented. For Pb(1-x)Sn(x)Te and Pb(1-y)Sn(y)Se, empirical relationships for n have been determined as a function of wavelength, composition, and temperature, using refractive index data previously measured in this laboratory. In the second part of this work, the laser performances of double heterojunction Pb(1-x)Sn(x)Te and Pb(1-y)Sn(y)Se injection lasers emitting 10.6 micrometer radiation and operated at 85K, were theoretically calculated. Threshold current and lasing output power as functions of compositions and laser geometry, were calculated as a guide for optimum design. Threshold current dansities of less than 200A/sq cm and output power of more than 2mW with 1A bias current were calculated for diodes of 1sq mm cross section, operated at 85K. Author (GRA)

N74-14433# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
FEASIBILITY OF USING CONVERSION ELECTRON MOSSBAUER SPECTROSCOPY FOR CHARACTERIZATION OF SURFACES AND THIN FILMS
Donald Gale Allen Jun. 1973 87 p refs
(AD-767219; GEP/PH/73-1) Avail: NTIS CSCL 07/4

Experimental techniques for the study of surfaces and thin films by the use of Mossbauer spectroscopy requires a detector that can isolate internal conversion electrons with energies of 7.3-keV or less. In addition, if the detector could energy-discriminate the electrons, changes occurring in a thin film, as the interface between the film and substrate is approached, could be observed. An electrostatic detector, employing parallel deflector plates and a channeltron electron multiplier, was designed and constructed for the purpose of obtaining Mossbauer spectra by detecting specific-energy electrons. Although the detector was capable of detecting the 7.3-keV, 5.6-keV, and 0.53-keV electrons emitted in the decay of a Co57 point source, attempts to obtain Mossbauer spectra were unsuccessful. A flowing-gas proportional counter, designed to detect internal conversion electrons, was used to obtain several Mossbauer spectra. Absorbers used for these spectra are discussed. (Modified author abstract) GRA

N74-14434# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING PRESSURE OF SATURATED VAPORS OF SOME SEMICONDUCTORS BY MEANS OF RADIOACTIVE ISOTOPES
M. G. Shakhtakhtinskii 12 Sep. 1973 90 p refs Transl. into ENGLISH from Tr. Inst. fiz. Akad. Nauk. Azerb. SSR (USSR), v. 11, 1963 p 52-107
(AF Proj. 7360)
(AD-768053; FTD-HT-23-496-73) Avail: NTIS CSCL 20/12

The object was to study the pressure of saturated vapors in a number of semiconductor compounds and solutions and to clarify certain processes which occur during evaporation. The most exact determination of saturated vapor pressure is obtained by using radioactive isotopes. In order to achieve the goal (test) devices and a work technique are developed. GRA

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N74-14435# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FORMATION OF THE CONDENSED PHASE IN A METALLIZED SOLID PROPELLANT ROCKET ENGINE
Paul Kuentzmann Aug. 1973 40 p refs In FRENCH; ENGLISH summary
(ONERA-TN-210) Avail: NTIS HC $4.00

Little is known about the formation mechanism of the condensed phase in the combustion products of a metallized solid propellant. An outline is given of the phenomena leading to formation and growth of alumina particles along with a prediction of the evolution of the condensed phased along its history, successively in the combustion zone, in the combustor and in the nozzle. In the combustion zone, which appears to be rather thin, particles are formed very early, either in vapor phase (d sub p = 0.01 to 0.1mu), or on the surface of aluminium particles (d sub p = 10 to 20mum). In the combustor, condensed and gaseous phases are approximately in equilibrium, and particle growth is due to turbulent diffusion and acoustic effects. An analysis scheme giving the distribution of the condensed phase in the nozzle inlet section is presented; in spite of uncertainties on the collision functions, a number of practical conclusions are proposed. Author

N74-14436# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
SOLID PROPELLANT COMBUSTION MECHANISM RESEARCH Annual Report, 1 Nov. 1972 - 30 Sep. 1973
M. Summerfield, L. H. Gaveny, T. J. Ohlemiller, N. Kubota, R. N. Battista, K. K. Kuo, and R. Vichnevetsky Aug. 1973 15 p refs
(Contract N00014-67-A-0151-0023; NR Proj. 092-516)
(AD-768195) Avail: NTIS CSCL 21/9

The annual report highlights the progress being made on several concurrent solid propellant combustion mechanism researches. Studies of nitrocellulose-base propellants have produced a broad range of experimental results for platonized and unplatonized propellants. The corresponding mathematical models consider the flame zone processes controlling temperature sensitivity, extinguishment limits, and burning rate. The analytical studies of ignition and burning of porous propellants are producing good agreement with data, new insights into the combustion processes, and establishing regimes where steady-state burning rates are achievable. The work of nonsteady burning has progressed to the point that rocket motor transients can be predicted and dynamic burning rates in a variable throat area, low L* motor can be measured; this work has progressed from the research phase to the development stage. Sub-micron pyrophoric aluminum is being investigated as a means of increasing propellant burning rate. Author (GRA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N74-14437 South Dakota State Univ., Brookings.
THE UNSTEADY CIRCULATION DISTRIBUTION IN ROTORS AND ITS APPLICATION TO NOISE STUDIES Ph.D. Thesis
Assem Fathy Aly Fathy 1973 103 p
Avail: Univ. Microfilms Order No. 73-22970

A new method for the calculation of the unsteady circulation distribution in axial flow compressors was developed. The classical assumption of representing the rotor by a two dimensional infinite cascade was eliminated. Instead the more realistic case of a radial cascade with blades of finite length was studied. The value of the circulation calculated using the present analysis was used in the classical theory of compressor noise prediction to study the effects of the different compressor design parameters on the noise generated under different types of inlet disturbances. The results suggest that in reaching an optimum design based on minimum noise both steady and unsteady loading effects must be taken into consideration. Dissert. Abstr.

N74-14438# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CALCULATION OF ELECTROSTATIC GUNS FOR ION PROPULSION
Marc Pointeau Mar. 1973 62 p refs In FRENCH; ENGLISH summary
(ONERA-TN-206) Avail: NTIS HC $5.25

Electrostatic focusing of an ion flux issued from a porous tungsten

pellet is described. The main equation governing the phenomenon is the Poisson equation: delta V = rho/epsilon sub omicron. It is solved in an iterative, self-consistent manner. The calculation of electric potential V is ensured by discretization and resolution of the matrix equation thus obtained by the over-relaxed Gauss-Seidel method. Space charge rho is obtained by flowrate conservation in stream tubes resting on three adjoining trajectories. The computation program thus established permits the study of two-dimensional or axi-symmetrical beams. A sub-program gives the beam divergence and the thrust. This program was used to test the optics of a button-type thrustor, and the influence of outlet beam neutralization on trajectories. Another program permits the treat of the deflection of a two-dimensional beam, and a third one to evaluate the electrode erosion by secondary ions. Author

N74-14439# Cranfield Inst. of Technology (England). School of Mechanical Engineering.
ESTIMATION AND OPTIMIZATION OF THE FILM COOLING REQUIREMENTS IN A GAS TURBINE COMBUSTION CHAMBER
D. R. Ballal Oct. 1973 35 p refs
(Cranfield-SME-5) Avail: NTIS HC $3.75

The film cooling requirements of a gas turbine combustion chamber over a typical aircraft flight path were investigated. A computational procedure is used to estimate and optimize the coolant flow for a given value of the metal temperature along the whole length of the liner wall. Results are presented for a variety of mainstream and slot flow conditions. The effects of different film cooling, geometries, mainstream turbulence, and hot gas acceleration were analyzed. Author

N74-14440# Cranfield Inst. of Technology (England).
A PROPOSED METHOD FOR CALCULATING FILM-COOLED WALL TEMPERATURES IN GAS TURBINE COMBUSTION CHAMBERS
D. R. Ballal and A. H. Lefebvre Jun. 1973 20 p refs
(Cranfield-SME-4) Avail: NTIS HC $3.00

A method for calculating the film cooled wall temperatures in gas turbine combustion chambers was developed. Thermal paint tests were conducted at pressures up to 30 atmospheres to confirm the theoretical procedures. The data are applied to minimizing the amount of air used for film cooling of the jet engine combustion chambers as a method for reducing the amount of air pollutants generated by the engine. Author

N74-14441*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID ROCKET ENGINE TURBOPUMP SHAFTS AND COUPLINGS NASA Space Vehicle Design Criteria (Chemical Propulsion)
Sep. 1972 130 p refs
(NASA-SP-8101) Avail: NTIS HC $4.50 CSCL 21H

Design criteria and recommended practices are presented for designing tubopump shafts and couplings. Design parameters, material selection, and structural analysis are discussed. F.O.S.

N74-14442*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
NUCLEAR ELECTRIC PROPULSION REACTOR CONTROL SYSTEMS STATUS
D. A. Ferg 15 Dec. 1973 30 p refs
(Contract NAS7-100)
(NASA-CR-136471; JPL-TR-32-1585) Avail: NTIS HC $3.50 CSCL 21F

The thermionic reactor control system design studies conducted over the past several years for a nuclear electric propulsion system are described and summarized. The relevant reactor control system studies are discussed in qualitative terms, pointing out the significant advantages and disadvantages including the impact that the various control systems would have on the nuclear electric propulsion system design. A recommendation for the reference control system is made, and a program for future work leading to an engineering model is described. Author

N74-14443# Junta de Energia Nuclear, Madrid (Spain).
IONIC PROPULSION
G. Velarde 1972 44 p refs In SPANISH
(JEN-251) Avail: AEC Depository Libraries $4.25

The inner parameters (electrons and ions velocity, current, thrust, power; specific impulse,...) and the outer parameters (velocity and operating time) of an ion propellant rocket are studied. The components (chamber dimensions, weights, propellants,...) are also described. Author (NSA)

N74-14444# Creare, Inc., Hanover, N.H.
MODELING A HIGH PRESSURE RATIO CENTRIFUGAL COMPRESSOR USING A LOW SPEED OF SOUND GAS Final Report
James A. Block and Peter W. Runstadler, Jr. May 1973 245 p refs
(Contract DAAJ02-70-C-0022; DA Proj. 1G1-62207-AA-71)
(AD-767241; USAAMRDL-TR-73-18) Avail: NTIS CSCL 21/5

The results of a program are presented which demonstrate that low-speed-of-sound modeling is a practical tool for the research and development of high-pressure-ratio, high-speed centrifugal compressors. The compressor air performance and the details of its internal fluid dynamics were replicated at reduced rotational speed when a low-speed-of-sound gas was used, providing inlet Mach number, Reynolds number, and gas specific heat ratio were duplicated. Duplication of inlet specific heat ratio was essential to accurate modeling of the air-equivalent flow rate. Stage pressure ratio and stage efficiency were found to be less sensitive to the accurate replication of air-equivalent inlet specific heat ratio. (Modified author abstract) GRA

N74-14445# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
RESEARCH ON NOISE GENERATED BY DUCTED AIR-FUEL COMBUSTION SYSTEMS Annual Report, 1 Mar. 1972 - 28 Feb. 1973
Edelbert G. Plett, H. H. Chiu, and Martin Summerfield Mar. 1973 33 p refs
(Contract N00014-67-A-0151-0029; NR Proj. 094-366)
(AD-767337; AR-2) Avail: NTIS CSCL 21/5

A two-pronged approach to the study of noise generation by combustion in a confined flow system, similar to a jet engine configuration, is described. One aspect deals with the mechanisms of noise generation by combustion; the other aspect deals with the effect of confinement on the noise generation and radiating properties of an unsteady solid-body-flow interaction. The mechanisms of noise generation by combustion are being studied analytically. It is noted that the steady flame structure determine the basic thermodynamic properties such as the sound speed and distribution of heat release, which affect amplification, dispersion and propagation of sound. The non-steady flame characteristics are responsible for noise generation; the turbulent scale, period and intensity affect the burning rate and heat release rate. The overall noise generation character is a superposition of the steady and non-steady acoustic characteristics. In studies with ducted and non-ducted sources, it is found that the interaction between the duct and the noise source can enhance the noise generation potential of the source region. The noise due to unsteady flow over small struts inside a duct is found to overwhelm the free jet noise up to speeds in excess of 1000 ft/sec. Author (GRA)

N74-14446# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF A NONDESTRUCTIVE METHOD TO MONITOR AND EVALUATE WORK CAPACITY OF TURBINE BLADES IN GAS TURBINE ENGINES
Yu. F. Belyaev, E. A. Konyaev, and A. Ya. Prishepov 17 Sep. 1973 14 p refs Transl. into ENGLISH from Vopr. Dinam. i Prochnosti (USSR), no. 214 1971 p 56-65
(AD-767994; FTD-HT-23-818-73) Avail: NTIS CSCL 21/5

The report describes the use of an electroinductive method for the nondestructive monitoring of the physical properties of an operating turbine blade. GRA

N74-14447# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIFE OF FATIGUE CRACKS ON ROTOR BLADES OF TURBINES IN GAS TURBINE ENGINES

V. A. Pivovarov 21 Sep. 1973 14 p refs Transl. into ENGLISH from Vop. Dinam. i Prochnosti (USSR), no. 214, 1971 p 46-55
(AD-767947; FTD-HT-23-817-73) Avail: NTIS CSCL 21/5

The report presents experimental data derived from tests performed on gas turbine blades to ascertain the relationship between cracks and blade fatigue life. GRA

N74-14448# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIFETIME OF TURBINE BLADES WITH DIFFERENT RUNNING TIMES IN OPERATION
L. I. Martynenko and L. V. Morozov 21 Sep. 1973 15 p refs Transl. into ENGLISH from Vopr. Dinam. i Prochnosti (USSR), no. 214, 1971 p 23-31
(AD-767957; FTD-HT-23-814-73) Avail: NTIS CSCL 21/5

The report presents the results of tensometric studies on blades during fatigue tests and the curves of their defect capacity during operation. GRA

N74-14449# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
FIELD TESTING OF AUTOMOTIVE ENGINES Final Report on Materiel Test Procedure
9 May 1973 11 p refs
(Proj. AMCR-310-6)
(AD-768011; TOP-2-2-721) Avail: NTIS CSCL 21/7

The report provides guidance for development testing of field performance of automotive engines installed in wheeled and tracked vehicles. It describes preliminary activities and requirements for initial inspection, servicing, and safety evaluation. It lists supporting tests including those applicable to engine performance under severe operating conditions. It provides supplementary instructions covering basic vehicle subtests and endurance, durability, and reliability. It is designed primarily for reciprocating internal combustion engines but applicable to other types. (Modified author abstract) GRA

N74-14450# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE THEORY OF AN ELECTROSTATIC METAL-PARTICLE SENSOR OPERATING IN A JET ENGINE EXHAUST M.S. Thesis
Jack Allen Labo Jun. 1973 74 p refs
(AD-768351; GEP/PH/73-13) Avail: NTIS CSCL 21/5

An electrostatic probe is studied as a charged metal particle detector in a jet engine exhaust from both a theoretical and experimental standpoint. The theoretical development concentrated on the electrostatic particle-probe interaction problem. The mechanism by which a moving charged particle induces a voltage pulse in a probe sensing circuit is studied and a practical model for the particle-probe system is developed and the resulting voltage pulses are explained by means of a capacitive equivalent electrical circuit. In order to predict the voltage pulse waveform, the changing capacitance between a moving charged particle and an electrostatic probe is determined, and the predicted voltage pulse is found to depend upon the particle charge and the probe sensing circuit. The interaction of an uncharged particle with a biased probe and the jet engine exhaust plasma effects are briefly discussed. (Modified author abstract) GRA

N74-14451# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WORK CAPACITY OF GAS TURBINE BLADES LOADED BY MULTIPLE START-UPS
Z. S. Pallei, A. T. Altukhov, C. M. Dorofko, L. F. Kokhanovskii, and E. V. Chemokhud 12 Sep. 1973 17 p refs Transl. into ENGLISH from Vopr. Dinam. i Prochnosti (USSR), no. 214, 1971 p 3-15
(AD-767958; FTD-HT-23-812-73) Avail: NTIS CSCL 21/5

The report studies the effect of natural engine start-ups on the work capacity of gas turbine rotor blades. Rotor blades of the third stage in a turbine from a AI-20 engine, which had previously accrued operational times of 2375 and 6000 h, were loaded in multiple start-up regimes. Residual life and the logarithmic decrement in vibrations were the parameters used to describe the strength of the rotor blades. Author (GRA)

N74-14452# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REGULARITIES IN THE ACCUMULATION OF DEFECTS IN MATERIALS DURING THERMOCYCLIC LOADING
Yu. F. Belrev and L. V. Morozov 17 Sep. 1973 13 p refs Transl. into ENGLISH from Vopr. Dinam. i Prochnosti (USSR), no. 214, 1971 p 39-45
(AD-767980; FTD-HT-23-816-73) Avail: NTIS CSCL 21/5

Some parts in gas turbine engines operate under nonstationary thermal loads, which substantially affects their life. In order to study the effect of nonstationary thermal loads on the lifetime of parts, the authors examined the effect of thermal shocks on the lifetime of two-dimensional specimens made from EI-435 steel. GRA

N74-14453# Fairchild Republic Div., Farmingdale, N.Y.
PULSED PLASMA PROPULSION TECHNOLOGY Interim Report, 10 May 1972 - 10 Mar. 1973
Dominic J. Palumbo and William J. Guman Sep. 1973 57 p refs
(Contract F04611-72-C-0053; AF Proj. 3058)
(AD-768224; MS147U100; AFRPL-TR-73-79) Avail: NTIS CSCL 21/3

A performance level compatible with the goal of 30% thrust efficiency at 1500 seconds specific impulse set for this program was successfully demonstrated with the parallel rail pulsed ablative thruster using Teflon propellant. Three studies were carried out in order to achieve this objective-parametric variations in which the effects of interelectrode spacing and electrode angle were evaluated: propellant studies wherein the performance of alternative thermoplastics was compared to Teflon, and Teflon seeded with elements having low ionization potentials for performance evaluation; and energy transfer studies, undertaken to assess quantitatively the major energy loss mechanisms associated with the thruster. Results of the parametric variations showed that a 20 degrees included angle between electrodes yields optimal performance at discharge energies up to 450J. At higher energies performance appears to be insensitive to this parameter. It was also demonstrated that increasing the interelectrode spacing leads to higher specific impulse and lower thruster/power at a given discharge energy. (Modified author abstract) GRA

N74-14454# Hercules, Inc., Magna, Utah.
TECHNIQUES FOR ASSESSING CASE LINER-BOND INTEGRITY IN SOLID PROPELLANT ROCKET MOTORS Final Report, 15 Dec. 1971 - 15 Jul. 1973
J. McKay Anderson, Terry D. Oavelka, and Ferry S. Bruno Sep. 1973 435 p refs
(Contract F04611-72-C-0009)
(AD-768315; AFRPL-TR-73-75) Avail: NTIS CSCL 21/8

The report documents results of an 18-month study program to develop improved methods for case bond structural analysis. The study was limited to unflawed bond systems in solid propellant rocket motors. In Task I of the program, parametric stress solutions were obtained for cylindrical motor configurations with flapped and right-angle bond terminations. In Task II of the program, improved test sample configurations were developed for the measurement of case bond tensile and shear strength. Based on results obtained from this program, techniques for the assessment of case bond integrity have been placed on a level equivalent to existing techniques for the assessment of grain integrity at the centerport. (Modified author abstract) GRA

N74-14455# Solar, San Diego, Calif.
LOW NOX EMISSION COMBUSTOR FOR AUTOMOBILE GAS TURBINE ENGINES
David J. White, P. B. Roberts, and W. A. Compton Feb. 1973 104 p
(Contract EPA-68-04-0016)
(PB-222818/7; RDR-1705-5; APTD-1441) Avail: NTIS HC $7.25 CSCL 13B

The aim was to develop, through both analytical and experimental studies, the basic design criteria and data necessary to produce a low emission combustor. This information was to be utilized in the production of two combustor designs, one for a typical low-pressure regenerative type of engine and the other for a high-pressure engine with partial recuperation. Several model

combustors were produced employing various concepts to obtain low emissions, and these were evaluated as to their suitability for incorporation into a practical engine system. GRA

N74-14276 Pratt and Whitney Aircraft, East Hartford, Conn.
DETAILED EXHAUST EMISSION MEASUREMENTS OF THREE DIFFERENT TURBOFAN ENGINE DESIGNS
A. W. Nelson *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

N74-14286 Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany). Engine Development and Testing Dept.
EXHAUST EMISSION MEASUREMENTS ON THE GE T64-7 TURBOPROP-ENGINE
W. Bergt, G. Kappler, and G. Meikis *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 4 p refs (For availability see N74-14271 05-20)

N74-14291* Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
PARAMETERS CONTROLLING NITRIC OXIDE EMISSIONS FROM GAS TURBINE COMBUSTORS
John B. Heywood and Thomas Mikus *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 16 p refs (For availability see N74-14271 05-20)
(Grant NGR-22-009-378)

N74-14292 California Univ., Berkeley. Dept. of Mechanical Engineering.
FACTORS CONTROLLING POLLUTANT EMISSIONS FROM GAS TURBINE ENGINES
R. F. Sawyer, N. P. Cernansky, and A. K. Oppenheim *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)
(Grants AF-AFOSR-2299-72; AF-AFOSR-2200-72)

N74-14294 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THEORETICAL STUDY OF THE RESIDUAL EVOLUTION OF POLLUTING PRODUCTS IN TURBOJET EXHAUSTS
Roland Borghi *In* AGARD Atmospheric Pollution by Aircraft Engine Sep. 1973 11 p refs In FRENCH; ENGLISH summary (For availability see N74-14271 05-20)

N74-14295 Pratt and Whitney Aircraft, West Palm Beach, Fla.
DEVELOPMENT AND VERIFICATION OF AN ANALYTICAL MODEL FOR PREDICTING EMISSIONS FROM GAS TURBINE ENGINE COMBUSTORS DURING LOW-POWER OPERATION
Stanley A. Mosier, Richard Roberts, and Robert E. Henderson (AFAPL) *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 12 p refs (For availability see N74-14271 05-20)

N74-14296 Politecnico di Milano (Italy). Ist. di Macchine.
AN EXPERIMENTAL RESEARCH ON THE BEHAVIOR OF A CONTINUOUS FLOW COMBUSTION CHAMBER
C. Casci, A. Coghe, U. Ghezzi, and S. Pasini *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 11 p refs (For availability see N74-14271 05-20)

N74-14298 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MODELIZATION OF TURBOMACHINE COMBUSTORS FOR POLLUTION STUDIES
Marcel Barrere *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 21 p refs In FRENCH; ENGLISH summary (For availability see N74-14271 05-20)

N74-14299 California Univ., Berkeley. Dept. of Mechanical Engineering.
SMOKE SUPPRESSANT ADDITIVE EFFECTS ON PARTICULATE EMISSIONS FROM GAS TURBINE COMBUSTORS
P. J. Pagni, L. Hughes, and T. Novakov *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 11 p refs (For availability see N74-14271 05-20)
(Grants NSF GK-27895; EPA-AP-385)

N74-14300 General Electric Co., Cincinnati, Ohio. Advanced Combustion and Emissions Control Technology.
TECHNOLOGY FOR THE REDUCTION OF AIRCRAFT TURBINE ENGINE EXHAUST EMISSIONS
Donald W. Bahr *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

N74-14301 Cranfield Inst. of Technology (England). School of Mechanical Engineering.
A PRELIMINARY STUDY ON THE INFLUENCE OF FUEL STAGING ON NITRIC OXIDE EMISSIONS FROM GAS TURBINE COMBUSTORS
A. H. Lefebvre and R. S. Fletcher *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 7 p refs (For availability see N74-14271 05-20)

N74-14302* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND EVALUATION OF COMBUSTORS FOR REDUCING AIRCRAFT ENGINE POLLUTION
Robert E. Jones and Jack Grobman *In* AGARD Atmospheric Pollution by Aircraft Engine Sep. 1973 8 p refs (For availability see N74-14271 05-20)

N74-14303 Societe Europeene d'Etudes et d'Essais d'Environnement, Buc (France).
MOTORIST POINT OF VIEW ON THE EFFECTS OF LOW BURNING RATES ON POLLUTION [POINT DE VUE DU MOTORISTE SUR LA CONCEPTION DES FOYERS A FAIBLE TAUX DE POLLUTION]
Alain Quillevere, Raymond Briancon, and Jean Decouflet *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 19 p refs In FRENCH (For availability see N74-14271 05-20)

N74-14304 Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
AIRCRAFT GAS TURBINE POLLUTANT LIMITATIONS ORIENTED TOWARD MINIMUM EFFECT ON ENGINE PERFORMANCE
Robert E. Henderson and William S. Blazowski *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 13 p refs (For availability see N74-14271 05-20)

N74-14671 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 4: PROPULSION AND ENERGY [FACHGEBIET 4: ANTRIEBE UND ENERGETIK]
In its DFVLR Annual Review, 1972 1972 p 199-281 refs (For availability see N74-14667 05-34)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear.

N74-14456 Virginia Univ., Charlottesville.
THE SMOOTHED DISTRIBUTION OF INTERSTELLAR ATOMIC HYDROGEN IN THE GALAXY Ph.D. Thesis
Alvin Curtis Miller 1973 94 p
Avail: Univ. Microfilms Order No. 73-25002

A broad beam survey of the 21-centimeter radiation from the interstellar atomic hydrogen in the galaxy was made toward eight positions 30 degrees apart along the NGP anti-center great circle where the effects of differential galactic rotation are a minimum. At each position the radio telescope, which had a twenty-seven degree beam pyramidal horn antenna, a five-channel load-switched Dicke receiver, and a negative-resistance type parametric amplifier for the first stage, integrated approximately 600 square degrees (1/70 of the whole sky) and 16.9 kilometers per second in velocity per channel. A total of thirty-one spectra were taken on eleven days between 19 June and 26 July, 1970. The smoothed distribution of hydrogen gas shows the general characteristics observed in earlier narrow beam

surveys; that is, the thin flat distribution closely aligned with the galactic plane, the presence of the Gould's Belt gas near the sun, and the local deficiency of gas at high positive latitudes. Dissert. Abstr.

N74-14457 California Univ., Riverside.
EARTH ALBEDO NEUTRONS FROM 10 TO 100 MeV Ph.D. Thesis
Alan Melvin Preszler 1973 178 p
Avail: Univ. Microfilms Order No. 73-23834

Neutrons produced in the atmosphere by the interaction of primary cosmic rays with the atmospheric nuclei were measured at energies from 10 to 100 MeV and angles from 20 deg to 80 deg to the vertical. The data were taken on a balloon flight from Palestine, Texas, 40 deg North geomagnetic latitude, on September 26, 1971. A telescope constructed of two large area tanks of liquid scintillator detected the incident neutron's energy and direction. Charged particle interactions were discriminated by an anticoincidence shield of plastic scintillator and gamma ray interactions were rejected by time of flight. Results of calibrations with neutrons of 55 and 15.3 MeV are presented. Data from ground level to 4.6 gm/cm2 of residual atmosphere were otained. The flux intensity variation with altitude of the cosmic ray-produced neutrons is seen to exhibit a peak at about 100 gm/cm2. Dissert. Abstr.

N74-14458*# Washington Univ., St. Louis, Mo. Lab. for Space Physics.
THE ORIGIN AND PROPAGATION OF VVH PRIMARY COSMIC RAY PARTICLES
G. E. Blanford, Jr., M. W. Friedlander, J. Klarmann, R. M. Walker, and J. P. Wefel [1972] 5 p refs
(Grants NGR-26-008-001)
(NASA-CR-136366) Avail: NTIS HC $3.00 CSCL 03B

Several source spectra were constructed from combinations of 4- and s-process nuclei to match the observed charge spectrum of VVH particles. Their propagation was then followed, allowing for interactions and decay, and comparisons were made between the calculated near-earth spectra and those observed during high altitude balloon flights. None of the models gave good agreement with observations. Author

N74-14459*# Stanford Univ., Calif. Radioscience Lab.
LOW FREQUENCY GYRO-SYNCHROTRON RADIO NOISE FROM THE EARTH'S OUTER RADIATION BELT Scientific Report
Michael S. Frankel May 1973 169 p refs
(Contracts NAS5-11387; NAS5-23205)
(SU-SEL-73-014) Avail: NTIS HC $10.50 CSCL 03B

The problem of detecting cyclotron and synchrotron noise from superthermal electrons is analyzed for the frequency range 30 kHz 300 kHz. Due to the earth's ionosphere, ground based observation of this noise is improbable. Therefore, the calculations are made for an observer in the interplanetary medium. In particular, the location is chosen in the geomagnetic equatorial plane at a geocentric distance of 32 earth radii. This position of the observer allows the theoretical results to be compared directly with data obtained from the radio astronomy experiment aboard the IMP-6 spacecraft. Author

N74-14460# Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany). Astronomischen Inst.
PROBABILITY CALCULATIONS FOR SUNSPOT CYCLE 21
W. Gleissberg 1973 9 p refs
(Rept-42) Avail: NTIS HC $3.00

Application of the improved formulations of the probability laws of sunspot variations leads to the following conclusions: it is to be expected with a probability of 80 per cent that, in Cycle 21, the ascending branch will be so long that the maximum will occur at least 30 months after the time when the smoothed monthly means of the sunspot relative numbers will have reached one quarter of their maximum value; and with a probability of 85 per cent that this maximum value will not exceed 106. Author

N74-14461*# Stanford Univ., Calif. Inst. for Plasma Research.
SOLAR ACTIVITY AND THE WEATHER Interim Report
John M. Wilcox Oct. 1973 45 p refs Presented at Symp. on Possible Relationships between Solar Activity and Meteorol. Phenomena, Greenbelt, Md., 7-8 Nov. 1973
(Grant NGR-05-020-559; Contract N00014-67-A-0112-0068; Grant NSF GA-31138; NR Proj. 323-003)
(NASA-CR-136313; SU-IPR-544) Avail: NTIS HC $4.25 CSCL 04B

The attempts during the past century to establish a connection between solar activity and the weather are discussed. Some critical remarks about the quality of much of the literature in this field are given. Several recent investigations are summerized. Use of the solar-interplanetary magnetic sector structure in future investigations is suggested to perhaps add an element of cohesiveness and interaction to these investigations. Author

N74-14462*# Stanford Univ., Calif. Inst. for Plasma Research.
ELEVEN-YEARS INVERSION OF THE GREEN CORONA EMISSION
Ester Antonucci Nov. 1973 14 p refs Submitted for publication
(Grant NGR-05-020-559; Contract N00014-67-A-0112-0068; Grant NSF GA-31138; NR Proj. 323-003)
(NASA-CR-136312; SU-IPR-549) Avail: NTIS HC $3.00 CSCL 03B

A cross correlation analysis of coronal green line intensity (5303A) and interplanetary magnetic field polarity for the period 1947-1970 shows that the coronal features are organized in a constant pattern with respect to the 4-sector structure through the solar cycle. A sudden inversion of the coronal pattern with respect to the sector structure takes place at the solar minima. The high emission regions of the green corona are located near the solar magnetic sector boundaries having polarities (-,+), (+,-), (-,+) during cycles 18, 19, 20 respectively in the Northern Hemisphere, and (+,-), (-,+), (+,-) in the Southern Hemisphere. Author

N74-14463*# Stanford Univ., Calif. Inst. for Plasma Research.
CORONAL MAGNETIC STRUCTURE AT A SOLAR SECTOR BOUNDARY Interim Report
John M. Wilcox and Leif Svalgaard Nov. 1973 20 p refs Submitted for publication
(Grant NGR-05-020-559; Contract N00014-67-A-0112-0068; Grant NSF GA-31138; NR Proj. 323-003)
(NASA-CR-136315; SU-IPR-574) Avail: NTIS HC $3.00 CSCL 03B

The persistent large-scale coronal magnetic structure associated with a sector boundary appears to consist of a magnetic arcade loop structure extending from one solar polar region to the other in approximately the North-South direction. This structure was inferred from computer coronal magnetic field maps for days on which a stable magnetic sector boundary was near central meridian, based on an interplanetary sector boundary observed to recur during much of 1968 and 1969. Author

N74-14464*# Stanford Univ., Calif. Inst. for Plasma Research.
RIGID AND DIFFERENTIAL ROTATION OF THE SOLAR CORONA Interim Report
Ester Antonucci and Leif Svalgaard Sep. 1973 17 p refs Submitted for publication
(Grant NGR-05-020-559; Contract N00014-67-A-0112-0068; Grant NSF GA-31138; NR Proj. 323-003)
(NASA-CR-136314; SU-IPR-539) Avail: NTIS HC $3.00 CSCL 03B

The rotation of the solar corona was studied using recurrence properties of the green coronal line (5303A) for the interval 1947-1970. Short-lived coronal activity is found to show the same differential rotation as short-lived photospheric magnetic field features. Long-lived recurrences show rigid rotation in the latitude interval + or - 57.5 deg. It is proposed that at least part of the variability of rotational properties of the solar atmosphere may be understood as a consequence of coexistence of differential and rigid solar rotation. Author

N74-14465*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GAMMA-RAY ASTROPHYSICS
Floyd W. Stecker, ed. and Jacob I. Trombka, ed. Washington 1973 425 p refs Symp. held at Greenbelt, Md., 30 Apr. - 2 May 1973; Sponsored jointly by NASA and the Am. Phys. Soc.
(NASA-SP-339) Avail: NTIS; SOD HC $2.90 CSCL 03B

Conference papers on gamma ray astrophysics are summarized. Data cover the energy region from about 0.3 MeV to a few hundred GeV and theoretical models of production mechanisms that give rise to both galactic and extragalactic gamma rays. For individual titles, see N74-14466 through N74-14495.

N74-14466* Wisconsin Univ., Madison.
DIFFUSE COSMIC X-RAYS BELOW 1 keV
William L. Kraushaar *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 3-13 refs (For availability see N74-14465 05-29)
CSCL 03B

A description is given of low energy soft diffuse X-ray flux in the energy region below 280 eV, the carbon-K edge. Spatial structure, nature of local emission, and intensity are also discussed. E.H.W.

N74-14467* American Science and Engineering, Inc., Cambridge, Mass.
THE X-RAY EMISSIVITY OF THE UNIVERSE: 2 TO 200 keV
Daniel Schwartz and Herbert Gursky *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 15-36 refs (For availability see N74-14465 05-29)
CSCL 03B

Observational results on the diffuse X-ray background between 2 and about 200 keV are presented. Data were analyzed in relation to volume emissivity. The UHURU and OSO-3 satellites and balloon flights served as data sources for the analysis. Author

N74-14468* Bologna Univ. (Italy).
ATMOSPHERIC CORRECTIONS TO BALLOON X-RAY OBSERVATIONS
H. Horstman *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 37-40 (For availability see N74-14465 05-29)
CSCL 03B

Atmospheric corrections made to balloon observed diffuse X-ray background between 30 and 200 keV are discussed. Corrections are based on a second balloon flight that carried detectors with different geometric factors and shapes and whose backgrounds were assumed to be the same. E.H.W.

N74-14469* California Univ., San Diego.
THE MEASUREMENT AND INTERPRETATION OF THE COSMIC GAMMA-RAY SPECTRUM BETWEEN 0.3 AND 27 MeV AS OBTAINED DURING THE APOLLO MISSION
L. E. Peterson, J. I. Trombka (NASA. Goddard Space Flight Center), A. E. Metzger (JPL), J. R. Arnold, J. I. Matteson (Los Alamos Sci. Res. Lab.), and R. C. Reedy *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 41-59 refs (For availability see N74-14465 05-29)
(Contracts NAS9-10070; NAS7-100; W-7405-eng-36)
CSCL 03B

The cosmic gamma ray background spectra measured by Apollo 15 between 0.3 and 27 MeV during transearth orbit are examined. Both discrete line spectra and diffuse sources were measured. Data are included on energy loss spectra, equivalent photon spectra, spallation corrections, and cosmic photon spectra. E.H.W.

N74-14470* Teledyne Brown Engineering, Huntsville, Ala.
INDUCED RADIOACTIVITY CONTRIBUTIONS TO DIFFUSE GAMMA-RAY MEASUREMENTS
G. J. Fishman *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 61-70 refs (For availability see N74-14465 05-29)

The effects of cosmic ray induced radioactivity on diffuse gamma ray measurements are analyzed. Data cover physical processes involved and the derivation of corrections due to induced radioactivity. E.H.W.

N74-14471* Lockheed Missiles and Space Co., Palo Alto, Calif.
PRELIMINARY RESULTS FROM THE FIRST SATELLITE OF A HIGH-RESOLUTION GERMANIUM GAMMA-RAY SPECTROMETER: DESCRIPTION OF INSTRUMENT, SOME ACTIVATION LINES ENCOUNTERED, AND STUDIES OF THE DIFFUSE SPECTRA
G. H. Nakano, W. L. Imhof, J. B. Reagan, and R. G. Johnson *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 71-75 refs Sponsored by ONR, and ARPA (For availability see N74-14465 05-29)
CSCL 03B

Gamma radiation from terrestrial and extraterrestrial sources were investigated with a high resolution Ge(Li) spectrometer-cryogen system flown onboard a low altitude, spin stabilized, polar orbiting satellite. A brief description is given of the instrument and preliminary results obtained from earth orbit are discussed. Attempts were made to use angular distributions and geomagnetic latitude spectral variations to determine diffuse background spectrum, detect gamma ray line emissions from solar flares, and search for positron annihilation radiation coming from the direction of the galactic center. E.H.W.

N74-14472* Lockheed Missiles and Space Co., Palo Alto, Calif.
PRELIMINARY RESULTS FROM THE FIRST SATELLITE OF A HIGH-RESOLUTION GERMANIUM GAMMA-RAY SPECTROMETER: BACKGROUNDS FROM ELECTRON BREMSSTRAHLUNG AND FROM ELECTRON-POSITRON ANNIHILATION
W. L. Imhof, G. H. Nakano, R. G. Johnson, and J. B. Reagan *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 77-82 refs Sponsored by ONR and ARPA (For availability see N74-14465 05-29)
CSCL 03B

Detailed data are presented on the bremsstrahlung backgrounds measured by a satellite-borne high resolution Ge(Li) gamma ray spectrometer. Two bremsstrahlung classes were discussed: (1) those arising from radiation belt electrons stopping in the vicinity of the spectrometer, and (2) bremsstrahlung produced by electrons precipitating into the earth's atmosphere. E.H.W.

N74-14473* Imperial Coll. of Science and Technology, London (England).
FURTHER CONSIDERATIONS OF SPALLATION EFFECTS c14
Clive Dyer *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 83-96 (For availability see N74-14465 05-29)
CSCL 20B

Trapped photon and cosmic ray effects on spallation in the UK-5 (hard X ray telescope) central crystal were measured. Both low dose and high dose effects were considered. Decay results are presented in tables. E.H.W.

N74-14474* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HEAO GAMMA-RAY ASTRONOMY EXPERIMENTS c30
A. Metzger *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 97-102 (For availability see N74-14465 05-29)
CSCL 03A

Two gamma ray experiments designed to measure and map the cosmic gamma ray spectrum in the 0.1 to 10 MeV region are outlined. The sensitivity and capability of the instruments- a high resolution gamma ray spectromenter that uses solid state detectors and a combined UCSD-MIT scintillation system are also given. These experiment were designed for the HEAO program. E.H.W.

N74-14475* Naval Research Lab., Washington, D.C.
RECENT OBSERVATIONS OF COSMIC GAMMA-RAYS FROM 10 MeV TO 1 GeV c30
Gerald H. Share *In* NASA. Goddard Space Flight Center

Gamma-Ray Astrophys. 1973 p 103-132 refs (For availability see N74-14465 05-29)
CSCL 03A

Recent observations of cosmic gamma rays made subsequent to the discovery of energetic protons from the galactic plane are discussed. The main areas covered include: (1) gamma ray emission from the plane galaxy, with emphasis on observations made in the vicinity of the galactic center, (2) gamma ray emission from the Crab nebula and its pulsar, and (3) diffuse gamma radiation. Author

N74-14476* Max-Planck-Institut fuer Plasmaphysik, Munich (West Germany).
REPORT ON GAMMA-RAY ASTRONOMY RESULTS OBTAINED IN EUROPE SINCE THE IAU SYMPOSIUM NO. 55 c30
K. Pinkau *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 133-137 refs (For availability see N74-14465 05-29)
CSCL 03A

Measurements of the diffuse flux and the Crab Pulsar NP 0532 are updated. Special attention is given to the energy spectrum of these two phenomena. E.H.W.

N74-14477* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY RESULTS ON SAS-2 OBSERVATIONS OF GREATER THAN 30 MeV GAMMA RADIATION
D. A. Kniffen, C. E. Fichtel, and R. C. Hartman *In its* Gamma-Ray Astrophys. 1963 p 139-152 refs (For availability see N74-14465 05-29)
CSCL 03B

A description is given of the SAS-2 detector and its measurements of gamma ray sources greater than 30 MeV. Results indicate that gamma rays come from discrete energetic sources, the galactic plane, and diffuse presumably extragalactic regions not associated with the galactic plane. E.H.W.

N74-14478* Smithsonian Astrophysical Observatory, Cambridge, Mass.
OBSERVATIONS OF HIGH-ENERGY GAMMA RAYS
G. G. Fazio (Harvard Coll. Obs.) *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 153-164 refs (For availability see N74-14465 05-29)
CSCL 03B

Ground based instruments designed to measure high energy gamma ray sources as a function of Cerenkov light bursts are described. Data are also included on the sensitivity, advantages, and disadvantages of the instruments. E.H.W.

N74-14479* New Hampshire Univ., Durham.
OBSERVATIONS OF GAMMA-RAY EMISSION IN SOLAR FLARES
D. J. Forrest, E. L. Chupp, A. N. Suri, and C. Reppin *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 165-174 refs (For availability see N74-14465 05-29)
CSCL 03B

Solar flare associated gamma ray observations are reviewed. Data cover He-3, line emission, and absolute intensity associated with gamma ray production. Results are given in graphs and tables. E.H.W.

N74-14480* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENERGY SPECTRA OF COSMIC GAMMA-RAY BURSTS
T. L. Cline, U. D. Desai, R. W. Klebesadel (Los Alamos Sci. Lab.), and I. B. Strong (Los Alamos Sci. Lab.) *In its* Gamma-Ray Astrophys. 1973 p 175-181 refs (For availability see N74-14465 05-29)
CSCL 03B

Detailed differential energy spectra from gamma ray bursts obtained by IMP-6 are presented. Observations cover times of occurance, photon flux, and temporal and spectral characteristics. E.H.W.

N74-14481* California Univ., Berkeley.
THE ASTROPHYSICS OF THE DIFFUSE BACKGROUND OF X-RAYS AND GAMMA RAYS
Ramanath Cowsik *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 185-210 refs (For availability see N74-14465 05-29)
(Grant NGR-05-003-376)
CSCL 03B

The orgin of diffuse X-ray and gamma ray background and some of the astrophysical implications of such a radiation background are discussed. Data show that gamma and X-rays come from thermal bremsstrahlung, neutral pion decay, and compton scattering of thermal protons. The range of energies studied extend from approximately 10 0 eV to approximately 10 to the 8th power eV. E.H.W.

N74-14482* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MECHANISMS FOR PRODUCTION OF THE DIFFUSE GAMMA-RAY CONTINUUM RADIATION
F. W. Stecker *In its* Gamma-Ray Astrophys. 1973 p 211-248 refs (For availability see N74-14465 05-29)
CSCL 03B

Basic mechanisms involved in the production of cosmic gamma radiation are outlined. They include Compton interactions with low energy protons, bremsstrahlung interactions, cosmic ray induced neutral pion production, and matter-antimatter annihilation. Detailed data are given on diffuse continuum radiation. Comparative data results are given in tables and graphs. E.H.W.

N74-14483* Academy of Sciences (USSR), Moscow.
GAMMA-RAY ASTRONOMY AND COSMIC-RAY ORIGIN THEORY c30
V. L. Ginzburg *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 249-257 refs (For availability see N74-14465 05-29)
CSCL 03A

A theory on the origin of cosmic rays is presented. Specifically, magellanic clouds and the galactic center were investigated as possible cosmic ray sources. E.H.W.

N74-14484* Durham Univ. (England).
GALACTIC GAMMA RAYS: MODELS INVOLVING VARIABLE COSMIC-RAY DENSITY
A. W. Strong, J. Wdowczyk, and A. W. Wolfendale *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 259-262 refs (For availability see N74-14465 05-29)
CSCL 03B

Mathematical models were developed to determine variable cosmic ray flux around the galactic plane. Data indicate point sources, molecular hydrogen concentration, increased cosmic ray density toward the galactic center, and neutral pion production combine to cause radiation density variables in the galactic plane. E.H.W.

N74-14485* Rice Univ., Houston, Tex.
PROSPECTS FOR NUCLEAR-GAMMA-RAY ASTRONOMY c30
Donald D. Clayton *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 263-289 refs (For availability see N74-14465 05-29)
(Grant NSF GP-18335)
CSCL 03A

Two sources of gamma rays from outside the solar system are considered. In particular, nucleosynthesis-supernova explosion and inelastic collisions are discussed. E.H.W.

N74-14486* Bell Telephone Labs., Inc., New York.
POSITRONIUM FORMATION RED SHIFT OF THE 511-keV ANNIHILATION LINE c24
M. Leventhal *In* NASA. Goddard Space Flight Center Gamma-Rays Astrophys. 1973 p 291-296 refs (For availability see N74-14465 05-29)
CSCL 20H

An examination was made of positronium formation in a gas and the 511 keV red shift spectrum produced by the formation. E.H.W.

N74-14487* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NUCLEAR GAMMA RAYS FROM SOLAR FLARES
R. Ramaty *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 297-314 refs (For availability see N74-14465 05-29)
CSCL 03B

Solar gamma ray line emission and the source of that emission at 0.5, 2.2, 4.4, and 6.1 MeV were reviewed and updated. Data were taken from OSO-7 observations of the August 4 and 7 solar flares. A comparison, made between predicted and observed emissions, show that the 0.5, 2.2, 4.4, and 6.1 MeV lines are produced by positron annihilation, deuterium deexcitation following neutron capture on hydrogen, and the deexcitation of the first nuclear levels of C-12 and O-16 respectively. Accelerated particle spectra at the sun independent of assumed interaction were determined. E.H.W.

N74-14488* Durham Univ. (England).
ULTRA-HIGH ENERGY GAMMA RAYS
A. W. Strong, J. Wdowczyk, and A. W. Wolfendale *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 315-327 refs (For availability see N74-14465 05-29)
CSCL 03B

The production of ultrahigh energy gamma rays by proton interactions with relicit radiation, propagation of gamma rays through the universe, and proton cascading in the presence and absence of galactic magnetic fields is discussed. Detailed data are given on proton spectrum link, gamma ray intensity, and energy spectra of gamma rays on production. E.H.W.

N74-14489* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPARISON OF THE RECENTLY OBSERVED SOFT GAMMA-RAY BURSTS WITH SOLAR BURSTS AND THE STELLAR SUPER-FLARE HYPOTHESIS
F. W. Stecker and K. J. Frost *In its* Gamma-Ray Astrophys. 1973 p 329-332 refs Submitted for Publication (For availability see N74-14465 05-29)
CSCL 03B

The possibility that soft gamma ray bursts are versions of X-ray bursts typically seen in solar flares and not products of supernovae events is investigated. Results show that the bursts have longer time scales that those predicted for supernovae events. It was suggested that the bursts result from the acceleration of electron bremsstrahlung to high energies in a stellar flare event. E.H.W.

N74-14490* Paris Univ. (France).
MATTER-ANTIMATTER COSMOLOGY **c30**
R. Omnes *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 335-350 refs (For availability see N74-14465 05-29)
CSCL 03B

Mechanisms responsible for the orgin and separation of matter and antimatter in the universe are discussed. Particular attention was given to coalesence. This mechanism involves annihilation production of along the boundary of matter-antimatter, high energy photons, electrons, and positrons. These particles together with secondary particles which they put into motion by collisions, carry their momentum to the matter or antimatter fluid. Coalescence and annihilation rates are discussed. E.H.W.

N74-14491* Observatoire de Paris-Meudon (France).
THE DEUTERIUM PUZZLE IN THE SYMMETRIC UNIVERSE **c30**
B. Leroy, J. P. Nicolle, and E. Schatzman *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 351-359 refs (For availability see N74-14465 05-29)
CSCL 03B

An attempt was made to use deuterium abundance in the symmetric universe to prove that no nucleosynthesis takes place during annihilation and therefore neutrons were loss before nucleosynthesis. Data cover nucleosynthesis during the radiative era, cross section estimates, maximum abundance of He-4 at the end of nucleosynthesis area, and loss rate. E.H.W.

N74-14492* Yale Univ., New Haven, Conn.
ANTIMATTER IN THE UNIVERSE **c24**
Gary Stigman *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 361-366 refs (For availability see N74-14465 05-29)
CSCL 20H

The means of detecting the presence of antimatter in the universe are discussed. Both direct, annihilation processes, and indirect, cosmic ray particles, were analyzed. All results were negative and it was concluded that no antimatter exists, if the universe is in fact symmetric. If the universe is not symmetric then matter and antimatter are well separated from each other. E.H.W.

N74-14493* Observatoire de Paris-Meudon (France).
GAMMA-RAY BACKGROUND SPECTRUM AND ANNIHILATION RATE IN THE BARYON-SYMMETRIC BIG-BANG COSMOLOGY
J. L. Puget *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 367-379 refs (For availability see N74-14465 05-29)
CSCL 03B

An attempt was made to extract experimental data on baryon symmetry by observing annihilation products. Specifically, gamma rays and neutrons with long mean free paths were analyzed. Data cover absorption cross sections and radiation background of the 0.511 MeV gamma rays from positron annihilations and the 70 MeV gamma rays from neutral pion decay. E.H.W.

N74-14494* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DISTORTION OF THE MICROWAVE BLACKBODY BACKGROUND RADIATION IMPLIED BY THE BARYON-SYMMETRIC COSMOLOGY OF OMNES AND THE GALAXY FORMATION THEORY OF STECKER AND PUGET **c30**
F. W. Stecker and J. L. Puget (Observatoire de Paris-Meudon) *In its* Gamma-Ray Astrophys. 1973 p 381-384 refs (For availability see N74-14465 05-29)
CSCL 03B

Theories on the distortion of microwave black body spectrum are presented. Data suggest that continuous annihilation of matter-antimatter, during all stages of universe evolution cause distortion by thermal energy distribution at red shifts less than 10,000. Data also show distortions in the Rayleigh-Jeans spectrum are caused by energy depositions at red shifts between 10,000 and 1,000 while those in the Wien spectrum are due to energy deposition at lower red shifts after the cosmic gas cools to its atomic state and thermalization does not take place properly. E.H.W.

N74-14495* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PANEL DISCUSSION ON THE FUTURE DIRECTION OF GAMMA-RAY ASTRONOMY **c30**
Giovanni G. Fazio (Smithsonian Astrophysical Obs.), Carl Fichtel, Glenn Frye (Case Western Reserve), Kenneth Greisen (Cornell Univ.), Albert Metzger (JPL), Evry Schatzman (Paris Obs.), Floyd Stecker, and Jacob Trombka *In its* Gamma-Ray Astrophys. 1973 p 387-406 (For availability see N74-14465 05-29)
CSCL 03A

A panel discussion was held on all data presented at the conference on Gamma Ray Astronomy. The present status and future directions of the science were outlined. E.H.W.

N74-14496*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR ENERGY POWER SYSTEM Patent Application
Billy K. Davis, inventor (to NASA) Filed 4 Dec. 1973 18 p (NASA-Case-MFS-21628-1; US-Patent-Appl-SN-421702) Avail: NTIS HC $3.00 CSCL 20M

A solar energy vapor (freon) powered system is described for generating electrical energy in which a portion of the heat absorbed from the sun in daylight is stored for use during darkness by a thermal capacitor. A mass of Pyrone, having a high thermal capacity, liquifies when heat is applied to it and goes through a solidification process to provide a heat output. A highly efficient solar boiler is constructed, utilizing an anodized titanium surface and a particular combination of shaped boiler tubes and complementary reflectors. The overall efficiency of the system is further improved by an arrangement of heat recovery devices. NASA

N74-14497*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DOUBLE SCATTERING CORRECTIONS FOR THE THEORY OF THE SUN'S AUREOLE
Adarsh Deepak 12 Dec. 1973 20 p refs
(NASA-TM-X-64800) Avail: NTIS HC $3.00 CSCL 03B

Double scattering corrections for aureole radiances are calculated by adding the effects of two successive single scatterings. Atmospheric absorption, polarization, and variation of refractive index with altitude are ignored. Corrections due to spherical atmosphere were taken into account by the use of a generalized Chapman function. Realistic scattering phase functions based upon the Lorenz-Mie theory and model altitude-size distribution are used. The model distribution is assumed to be representable in terms of two separable particulate components. It was found that for a moderately clear day, tau (0) is approximately equal to 0.5, and for forward scattering angles, the radiance, B sub 2, due to double scattering is less than 6 percent of that due to single scattering. Author

N74-14498*# California Univ., Riverside. Inst. of Geophysics and Planetary Physics.
TIME CORRELATION OF HEAVY COSMIC RAY NUCLEI
Starnes Elbert Walker Sep. 1973 100 p refs
(Grant NGR-05-008-002; Contract N00014-69-A-0200-5004) (NASA-CR-136365; AD-768358; IGPP-UCR-42; TR-12) Avail: NTIS HC $7.00 CSCL 04A

The time variation of heavy cosmic ray nuclei over a 4.5 hour period has been investigated. The results were obtained from a balloon flight from Ft. Churchill, Manitoba, 73 degrees North geomagnetic latitude, on July 22, 1972. Identifying the charge and kinetic energy/nucleon of incident, heavy cosmic ray nuclei by four simultaneous dE/dx measurements and an active time of flight measurement, a detector was lifted by balloon to the top of the atmosphere where only 0.4% of residual atmosphere remained. During the 19 hours at float altitude, a continuous 4.5 hours were allocated to the heavy nuclei experiment. The magnitude of the galactic, heavy nuclei flux is perturbed during solar activity. With the high event rate capability of the particle spectrometer, the results of the time correlation showed no statistically significant evidence of small pertubations from the average intensity for the incident heavy nuclei with kinetic energies = 350 MeV/nucleon over the 4.5 hour exposure period. Minimal solar activity from July 17 through July 23 of 1972 supports this result. In addition, no evidence of a direct diurnal anisotropy consistent with the corotation of galactic heavy nuclei with the solar magnetic field was observed. (Modified author abstract) GRA

N74-14499# Maryland Univ., College Park. Dept. of Mechanical Engineering.
PROCEEDINGS OF THE SOLAR HEATING AND COOLING FOR BUILDINGS WORKSHOP. PART 1: TECHNICAL SESSIONS, MARCH 21 AND 22
Redfield Allen Jul. 1973 231 p refs Workshop held Washington, D. C., 21-23 Mar. 1973
(Grant NSF GI-32488)
(PB-223536/4GA; NSF-RA/N-73-004) Avail: NTIS HC $3.00 CSCL 13A

The proceedings contain thirty-six technical papers on solar energy for U.S. building applications areas; namely, solar collectors, energy storage, domestic hot water heating, energy conservation and insulation, solar air-conditioning, and systems for solar heating and cooling. Some foreign activities are also reviewed. Each technical paper is a report on: proposed reseach, on-going research, proposed systems, or operating systems. Questions and answers from the discussion periods are included, as is an agenda and list of attendees. GRA

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N74-14500 Virginia Univ., Charlottesville.
EXCITATION OF INTERSTELLAR HYDROGEN CYANIDE IN THE ORION MOLECULAR CLOUD Ph.D. Thesis
Frank Oliver Clark 1973 167 p
Avail: Univ. Microfilms Order No. 73-24956

A new and potentially powerful method was used to analyze microwave observations of interstellar hydrogen cyanide in the Orion molecular cloud. This method incorporates recent work on collapsing protostellar clouds, detailed excitation calculations, and numerical solution of the equation of radiative transfer. Excellent agreement with oservations is achieved. The results of this type of analysis are number density per cubic centimeter of H2 and all observed HCN isotopes. Relative abundances of the molecular isotopes of HCN clearly show nonterrestrial abundances, if interpreted as reflecting elemental isotopic abundances. The number density per cubic centimeter is somewhat sensitive to the poorly known collisional cross section of interaction, while the molecular isotopic ratios are less so. This type of analysis clearly shows the necessity of including the density gradient and meaningful excitation in spectral line analysis.
Dissert. Abstr.

N74-14501 California Univ., San Diego.
DIGICON SPECTROPHOTOMETRY IN ASTRONOMY Ph.D. Thesis
Edward Alexander Beaver 1973 118 p
Avail: Univ. Microfilms Order No. 73-23173

A study of digital imagery techniques has led to the development of a new type of instrument and its research application in astronomy. The digicon is a multichannel photon counter consisting of a magnetically focused image tube, and a diode-array target with pulse counting electronics. The performance characteristics have been studied in detail and indicate the device is useful in precision light measurements. The device was attached to various telescopes for research in astronomy. Accurate photoelectric plots of Balmer H gamma line profiles of 12 A and B stars are compared with other photographic and scanner data. Also the H gamma feature of five white dwarfs in the Hyades cluster allows comparison with theory and determination of gravities, mass, and radius. A photoelectric plot of the Lyman Alpha absorption feature of PHL 957 with night sky substracted is presented and discussed. Dissert. Abstr.

N74-14502 Houston Univ., Tex.
VOLATILIZATION-QUADRUPOLE MASS SPECTROMETRIC ANALYSIS OF APOLLO 11, 12, AND 14 LUNAR SAMPLES, 1. SEARCH FOR ORGANIC COMPOUNDS IN SIMULATED LUNAR AND MARTIAN ATMOSPHERES, 2 Ph.D. Thesis
Satish K. Gupta 1973 184 p
Avail: Univ. Microfilms Order No. 73-22908

The first part of this study involves the mass spectrometric analysis of the volatiles released upon temperature programmed thermal treatment of Apollo 11, 12, and 14 lunar fines and rock samples. Most of the water and carbon dioxide released at lower temperature are shown to be the results of atmospheric adsorption. The fraction of water released above 400 C may have been formed on the lunar surface due to proton irradiation. The second part of this investigation constituted the search for organic and biogenic compounds using electric discharge and ultraviolet light as the sources of energy in simulated lunar and Martian atmospheres, respectively. The aqueous phase analysis in the electric discharge experiment did not show the formation of any new compound as a result of the action of the electric discharge. Some hydrocarbons detected were shown to be formed by the action of thermal energy associated with the electric discharge. Dissert. Abstr.

N74-14503 Michigan Univ., Ann Arbor.
OPTIMAL THREE DIMENSIONAL MANEUVERS OF ROCKET POWERED HYPERVELOCITY VEHICLES WITH LIFT, BANK ANGLE AND THRUST CONTROLS Ph.D. Thesis
Joseph Warren Griffin, Jr. 1973 203 p
Avail: Univ. Microfilms Order No. 73-24577

A number of important three dimensional atmospheric trajectory optimization problems are solved analytically using the methods and techniques of modern optimal control theory. Analytical solutions are obtained in closed form for the three dimensional optimal maneuvering of a rocket powered vehicle

with lift and bank angle capabilities flying in the hypervelocity regime in the earth's atmosphere. The optimal control problem consists of finding the optimal lift, bank angle and thrust magnitude control programs used to fly the vehicle from a set of specified initial conditions to a set of terminal conditions (which may or may not be prescribed) such that a selected terminal state variable is maximized. These may include terminal velocity, altitude, heading angle and vehicle mass. The problem is formulated for a spherical non-rotating planet with an exponentially varying atmospheric mass density. Dissert. Abstr.

N74-14504 Virginia Univ., Charlottesville.
PROPOSED ULTRAVIOLET STUDIES OF INTERSTELLAR POLYATOMIC MOLECULES AND SUPPORTING RADIO OBSERVATIONS Ph.D. Thesis
Paul Theodore Giguere 1973 141 p
Avail: Univ. Microfilms Order No. 73-25005

A study was made of areas in which ultraviolet spectroscopy offers advantages in studying interstellar medium through observation of polyatomic molecules. A list of O and B stars that are potential candidates for future UV polyatomic molecule searches is given. Seven of these stars were observed in the J = 1-0 line of HCN. Positive radio results were obtained for two stars, Herschel 36 and Anon 1/NGC 7538. Calculations are presented which show that a benzene search should receive a high priority in UV studies of stars such as Herschel 36. A radio search for fulvene, an isomer of benzene, with negative results, is described. The problem of detecting optical rotatory dispersion (ORD) caused by interstellar optically active molecules is considered, with particular emphasis given to the simpler amino acids, especially alanine. Dissert. Abstr.

N74-14505 Colorado Univ., Boulder.
OPTIMUM TRANSFER BETWEEN HYPERBOLIC ASYMPTOTES ABOUT A PLANET ON FINITE SIZE Ph.D. Thesis
James Michael Walton 1973 278 p
Avail: Univ. Microfilms Order No. 73-23307

With the current planning for multiple planet and roundtrip planetary swingby missions, the transfer between two given hyperbolic trajectories has become a natural problem of interest. For a particular planetary pass the obvious problem formulation is to specify a hyperbolic arrival velocity vector and a desired hyperbolic departure velocity vector, both far from the planet. A transfer between these states is to be determined subject to the common optimization criterion of minimizing the characteristic velocity of the maneuver. The usual assumption of a point mass planet, with no restriction on the time elapsed during the transfer, leads to the result that the optimal transfer requires zero characteristic velocity. In order to achieve meaningful results, the additional restriction of a planet of finite size is necessary. The results of this research provide the means for determining the optimal transfer type for any set of initial and final conditions. In addition, methods were developed to calculate the details of the resulting optimal transfer types. Dissert. Abstr.

N74-14506# Joint Publications Research Service, Arlington, Va.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO 314
13 Dec. 1973 43 p refs Transl. into ENGLISH from various Soviet bloc periodicals
(JPRS-60775) Avail: NTIS HC $4.25

Translations and abstracts are reported of articles on meteorology, oceanography, upper atmosphere and space research, astronomy and terrestrial geophysics, covering both science news and formal scientific reports. Published details of Soviet space spectaculars are included. Author

N74-14507*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A FINE POINTING SYSTEM FOR THE LARGE SPACE TELESCOPE
Werner O. Schiehlen (NAS-NRC) Washington Dec. 1973 75 p refs
(NASA-TN-D-7500; M-217) Avail: NTIS HC $3.50 CSCL 03A

The large space telescope (LST) developed by NASA requires ultrahigh pointing stability within 0.0005 arc sec rms. A fine guidance system is proposed to body-point the entire spacecraft within this limit. The spacecraft is modeled as a rigid body having reaction wheel actuators and subject to gravitational and magnetic disturbance torques. The fine guidance sensor is cluttered with electronic noise. The disturbance accommodation standard deviation optimal controller (DASOC) is designed to be optimal with respect to the transient and the steady state response to noise, whereas the steady state response to deterministic external torques is exactly zero. Compared with conventional controllers, the fine guidance system with the DASOC offers as much as a factor of 30 improvement in pointing stability, resulting in an optimal performance of nearly 0.0001 arc sec rms. Thus, the required pointing stability can easily be obtained, and a large margin remains for the compensation of possibile deteriorations. Author

N74-14508*# Scientific Translation Service, Santa Barbara, Calif.
THE COSMONAUT AS RESEARCHER
N. N. Rukavishnikov and G. I. Morozov Washington NASA Dec. 1973 61 p refs Transl. into ENGLISH of the publ. "Kosmonavt-Issledovatel" Moscow, Znaniye, 1973 64 p
(Contract NASw-2483)
(NASA-TT-F-15196) Avail: NTIS HC $5.25 CSCL 22C

The possibilities which have opened up for science due to experiments carried out directly in space are discussed, as well as results obtained from the flights of cosmonauts. The cosmonaut profession and flight training are examined. Future trends in the development of manned space technology are briefly investigated. Author

N74-14509*# Arizona Univ., Tucson.
COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME 10, PART 1
Gerard P. Kuiper, ed. 1973 103 p refs Sponsored by NASA Original contains color illustrations
(NASA-CR-136254; LC-62-63619; COMM-184-195) Avail: NTIS HC $7.25 CSCL 03B

Research reports and observational summaries prepared by the laboratory staff are presented. For individual titles, see N74-14510 through N74-14521.

N74-14510* Arizona Univ., Tucson.
REFLECTION SPECTRA OF SOLIDS OF PLANETARY INTEREST
Godfrey T. Sill *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 1-7 refs (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 03B

The spectra of solids are reproduced which might be found on the surfaces of planetary bodies or as solid condensates in the upper planetary atmosphere. Among these are spectra of various iron compounds of interest in the study of the clouds of Venus. Other spectra are included of various sulfides, some at low temperature, relevant to the planet Jupiter. Meteorite and coal abstracts are also included, to illustrate dark carbon compounds. Author

N74-14511* Arizona Univ., Tucson.
REFLECTION SPECTRA, 2.5-7 MICRONS, OF SOME SOLIDS OF PLANETARY INTEREST
U. Fink and S. D. Burk *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 8-20 refs (For availability see N74-14509 05-30)
CSCL 03B

Reflection spectra of 42 compounds of possible planetary interest were run from 2.5 to 7 microns. They were supplemented by some transmission spectra extending the wavelength coverage to 15 microns. The spectra were organized according to their constituent radicals and an attempt was made at the identification of the absorption features. Author

N74-14512* Arizona Univ., Tucson.
INFRARED SPECTRA OF THE GALILEAN SATELLITES OF JUPITER
Uwe Fink, Nicolaas H. Dekkers, and Harold P. Larson *In its*

Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 21-27 refs Repr. from Ap. J. Letters, v. 179, no. 3, 1 Feb. 1973 p L155 (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 03B

Spectra of the four Galilean satellites from 1 to 4 microns were obtained with a Michelson interferometer. The spectra show that the albedo of Io is very nearly constant with wavelength; no absorptions are found in the region observed. Europa and Ganymede have large amounts of water ice on their surface. Callisto shows some faint ice absorptions. Upper limits of 0.5 cm-atm (STP) corresponding to 6 x 10 to the minus 8th power atm partial surface pressure were set for CH4 and NH3 on all four satellites. Author

N74-14513* Arizona Univ., Tucson.
COMMENTS ON THE GALILEAN SATELLITES
Gerard P. Kuiper *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 28-34 refs (For availability see N74-14509 05-30)
CSCL 03B

The surface deposits of the Galilean satellites, especially Io, are examined in the light of some early and some very recent observations. Io, with probably a thin sulfur deposit in the lower latitudes and orange polar caps presumably composed of sulfur compounds, stands apart from the other three satellites. Author

N74-14514* Arizona Univ., Tucson.
THE RED POLAR CAPS OF Io
R. B. Minton *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 35-39 Original contains color illustrations (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 03B

An excellent series of Jupiter photographs obtained on August 9, 1973 showed Io to have red-brown polar caps, with the South Cap substantially larger than the North Cap. Reproductions are shown in the color Plate. The polar caps stand out by the color contrast against a white-bluish zone of Jupiter. When projected against a brown belt, only the truncated brighter equatorial region of the satellite is seen. Some 1968 images of Io also show the color of the polar caps directly. Author

N74-14515* Arizona Univ., Tucson.
COLOR PHOTOGRAPHY OF JUPITER
S. M. Larson, J. W. Fountain, and R. B. Minton *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 40-41 refs Original contains color illustrations (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 03B

Selected color photographs of Jupiter taken with the 154-cm Catalina reflector from October 1965 to September 1973 are presented. Eight oppositions are covered showing the developments in cloud belt structure and color distribution of the Jovian atmosphere. Author

N74-14516* Arizona Univ., Tucson.
A REAL-TIME COMPUTER FOR MONITORING A RAPID-SCANNING FOURIER SPECTROMETER **c08**
Guy Michel *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p refs Repr. from Appl. Opt., v. 11, Nov. 1972 p 2671-2674 (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 09B

A real-time Fourier computer has been designed and tested as part of the Lunar and Planetary Laboratory's program of airborne infrared astronomy using Fourier spectroscopy. The value and versatility of this device are demonstrated with specific examples of laboratory and in-flight applications. Author

N74-14517* Wisconsin Univ., Madison. Space Science and Engineering Center.
ON THE CAPABILITIES OF THE SPIN-SCAN IMAGING TECHNIQUE **c14**
T. Gehrels, V. E. Suomi, and R. J. Krauss *In* Ariz. Univ. Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 49-53 refs Repr. from Space Res., v. 12, 1972 p 1765-1769 Presented at COSPAR Meeting, Seattle, Dec. 1971 (For availability see N74-14509 05-30)
CSCL 14E

A summary description is made of spin-scanning devices for various space missions. Compared to television, scan-imaging has remarkable advantages and these are listed. Author

N74-14518* Arizona Univ., Tucson.
HIGH RESOLUTION PLANETARY OBSERVATION
Gerard P. Kuiper *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 54-59 refs Repr. from Space Res., v. 12, 1972 p 1683-1687 Presented at COSPAR Meeting, Seattle, 21 Jun. - 2 Jul. 1971 (For availability see N74-14509 05-30)
CSCL 03A

High-resolution ground-based planetary observations, visual and photographic, have, for several decades, seemed to have reached a rather firm limit. The causes for this restriction are briefly reviewed. At the time when space probes make major advances possible, at incomparably higher levels of expenditure, the need arises to re-examine the limiting factors of earth-based planetary resolution. In addition to familiar refinements (of which seven are listed) carried somewhat further, a specific approach, yet insufficiently developed, is the study of the atmospheric boundary layer over the observatory site and the use of an appropriately elevated station. Author

N74-14519* Arizona Univ., Tucson.
WATER-VAPOR MEASURES, MT. LEMMON AREA **c13**
Gerard P. Kuiper and L. Randic *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 60-69 (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 04A

Daytime atmospheric water-vapor measures were continued for Mt. Lemmon, the Catalina Observatory, and Tucson. As before (LPL Comm. No. 158), the three sets are closely related in terms of their altitude differences, with the average empirically-determined scale-height value, 2.3 km. During the winter and spring of 1971 observations were made for more than 90% of the days. The measures are listed in tables and for comparison, the 1969-70 data published in LPL Communication No. 158 are given. The averages for the stations are also shown. Author

N74-14520* Arizona Univ., Tucson.
ECCENTRICITY AND INCLINATION OF MIRANDA'S ORBIT
Ewen Whitaker and Richard Greenberg *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 70-80 refs (For availability see N74-14509 05-30)
(Grant NGL-03-002-002)
CSCL 03A

Careful re-measurement of all available plates showing Uranus V (Miranda), supplemented by some recently obtained images, shows that this satellite has both a pronounced orbital eccentricity and inclination (to the plane of the other satellites). Observations are sufficient in number and distribution to allow determinations of the precession rates of both pericenter and node, with implications for the dynamical oblateness of Uranus and the gravitational interaction of the satellites. An improved value for the revolution period is a byproduct of the investigation. The success of the study is due to the improved precision of the measures resulting from the adoption of a very simple, direct method of measurement. Author

N74-14521* Arizona Univ., Tucson.
A MODEL OF THE EASTERN PORTION OF SCHROETER'S VALLEY
Ralph Turner *In its* Commun. of the Lunar and Planetary Lab., Vol. 10, Part 1 1973 p 81-93 refs (For availability see N74-14509 05-30)
(Grant NGL-03-002-191)
CSCL 03A

A relief model of the eastern portion of Schroter's Valley was completed using Lunar Orbiter, Apollo 15, and earth-based photography. The main results derived from this study are as follows: (1) the head of the valley is not a simple crater, but rather a slightly-widened section of the valley emanating from a

shield, (2) the east side of the Cobra head is a very high peak (2.3 km above the surrounding plains) forming part of a broad shield with an average slope of 12 deg, and (3) both sides of the valley display a raised rim in the region measured. These and other observations indicate the valley was formed by fluid processes, probably lava, and that the valley may therefore be a lava drainage channel, the drained lava presumably underlying the more recent Oceanus Procellarum basalts. Author

N74-14522# Harvard Univ., Cambridge, Mass. Hoffman Lab.
EXPERIMENTAL PETROLOGY AND ORIGIN OF TITANIFEROUS LUNAR BASALTS
D. Walker, J. Longhi, E. Stolper, T. Grove, and J. F. Hays [1973] 3 p refs
Avail: NTIS HC $3.00 CSCL 03B

The compositional variation of titaniferous basalts, from Tranquility Base and Taurus-Littrow, are discussed along with crystallization models. F.O.S.

N74-14523*# Kanner (Leo) Associates, Redwood City, Calif.
TRANSFER OF LONG WAVE RADIATION IN THE LOWER ATMOSPHERE OF VENUS
M. Ya. Marov and V. P. Shari Washington NASA Jan. 1974 33 p refs Transl. into ENGLISH of "Perenos Dlinnovolnovogo Izlucheniya v Nizhney Atmosfere Venery", Acad. of Sci. USSR, Inst. of Appl. Math., Moscow, Preprint No. 23
(Contract NASw-2481)
(NASA-TT-F-15259) Avail: NTIS HC $3.75 CSCL 03B

Radiative heat flows in the subcloud atmosphere based on the latest data on the Venusian atmosphere were calculated, using new results on the absorption of the main atmospheric constituent: carbon dioxide gas. Assuming a value of A = 0.77 + or - 0.01 for the integral albedo of Venus, the exiting thermal radiation flux at all altitudes considerably exceeds the mean inflow of solar energy. Even for a relative H20 content of .00001, the balance cannot be achieved. But the exiting thermal radiation flux can be reconciled with the incoming solar flux for the same or smaller albedo if the relative H20 content in the atmosphere is approximately 0.1%. The most substantial contribution to radiation transfer is made by the 4050-4650 1/cm window between the 2.7 and 2.0 micrometers CO2 bands: the upper half of the subcloud atmosphere accounts for more than 60% total thermal flux. Author

N74-14524*# Kanner (Leo) Associates, Redwood City, Calif.
INTERPRETATION OF THE MEASUREMENT OF ILLUMINATION ON THE VENERA 8 INTERPLANETARY AUTOMATIC STATION
H. L. Lukashevich, M. Ya. Marov, and Ye. M. Feygelson Washington NASA Jan. 1974 18 p refs Transl. into ENGLISH of "Interpretatsiya Izmereniy Osveshchennosti na Avtomaticheskoy Mezhplanetnoy Stantsii Venera-8", Acad. of Sci., USSR, Inst. of Applied Math., Moscow, Preprint No. 63, 1973 20 p
(Contract NASw-2481)
(NASA-TT-F-15260) Avail: NTIS HC $3.00 CSCL 03B

Illumination in the Venusian atmosphere was first measured on the Venera 8 Automatic Station. The principal finding was that the dense Venusian molecular atmosphere enclosed from above by the cloud layer transmits solar light to the planetary surface, though very greatly attenuated. Two atmospheric layers with differing optical density were also found: from 50 to 35 km, and from 35 km to the surface. Two models of the Venusian atmosphere were examined to find the one providing closer agreement between theoretical and calculated light flux values for several atmospheric layers. The second model postulating spreading of the cloud layer downward from its base of 60 km to the 35 km level was found to yield closer agreement. Author

N74-14525*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
TECHNIQUES FOR SHUTTLE TRAJECTORY OPTIMIZATION Final Report
E. R. Edge, C. J. Shieh, and W. F. Powers Dec. 1973 129 p refs
(Contract NAS9-12872)
(NASA-CR-134169; Rept-011482-F) Avail: NTIS HC $8.50 CSCL 22A

The application of recently developed function-space Davidon-type techniques to the shuttle ascent trajectory optimization problem is discussed along with an investigation of the recently developed PRAXIS algorithm for parameter optimization. At the outset of this analysis, the major deficiency of the function-space algorithms was their potential storage problems. Since most previous analyses of the methods were with relatively low-dimension problems, no storage problems were encountered. However, in shuttle trajectory optimization, storage is a problem, and this problem was handled efficiently. Topics discussed include: the shuttle ascent model and the development of the particular optimization equations; the function-space algorithms; the operation of the algorithm and typical simulations; variable final-time problem considerations; and a modification of Powell's algorithm. Author

N74-14526# Atomic Energy Commission, Oak Ridge, Tenn. Technical Information Center.
PULSARS BIBLIOGRAPHY
W. D. Matheny Aug. 1973 129 p refs
(TID-3320(S3)) Avail: NTIS HC $5.45

This bibliography consists of 770 abstracts taken from Nuclear Science Abstracts, Vol. 26 and Vol. 27. The time period covered is 1972. Author (NSA)

N74-14527# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
POWER LUNAR RENDEZVOUS GUIDANCE M.S. Thesis
Lawrence E. Baughn, Jr. and James Edward Leach Jun. 1973 106 p refs
(AD-768355; GGC/EE/73-2) Avail: NTIS CSCL 22/3

A computer program was developed to simulate the rendezvous of an ascending lunar shuttle on a biellipitic transfer orbit with an earth shuttle on a free-return circumlunar trajectory. The effects of the gravitational perturbations due to the earth and sun on the transfer trajectory were corrected by an equation which predicted these perturbations. Finite burn periods were used for the transfers into the unguided coasting timing semi-ellipses. A previously proposed timing system was developed and refined. Two controllers were investigated for the terminal guidance portion of the rendezvous trajectory. A linearized suboptimal method was developed using a set of Riccati equations and was applied successfully. A reduced-memory optimization scheme was also developed, but could not be successfully implemented. Since the optimal control was not achieved by the attempted method, results are presented only for the linearized scheme. Author (GRA)

N74-14528# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OPTIMAL TRUNCATED-POWER SERIES APPROACH FOR DIFFERENT REENTRY PHASES M.S. Thesis
Phillip C. Hollister Jun. 1973 86 p refs
(AD-768356; GGC/EE/73-6) Avail: NTIS CSCL 22/3

The optimal reentry problem is formulated for a phase by phase planar trajectory. The reentry portion of the trajectory for a shuttle type vehicle is divided into two phases and each phase is treated as an individual optimal control problem. Optimization is with respect to; (1) peak heat rate for the entry phase, (2) a combination of total control energy, total heat absorbed, and satisfactory end conditions for the glide phase, and (3) a total surface distance. The control for each phase consists of a truncated power series as a function of the system states and the independent variable range. The entry phase ends at pullup and has a single constant for control. The glide phase ends at conditions desired for a transition from a high to a low angle of attack, the transition phase is left for a later study. By process of elimination the glide phase control form is reduced to a constant plus two terms. Searching for the coefficients which optimize the power series is accomplished using Davidon's minimization routine. Results indicated that a constant adaptive controller is a reasonable sub-optimal solution for both phases. (Modified author abstract) GRA

N74-14474* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HEAO GAMMA-RAY ASTRONOMY EXPERIMENTS
A. Metzger *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 97-102 (For availability see N74-14465

05-29)
CSCL 03A

N74-14475* Naval Research Lab., Washington, D.C.
RECENT OBSERVATIONS OF COSMIC GAMMA-RAYS FROM 10 MeV TO 1 GeV
Gerald H. Share *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 103-132 refs (For availability see N74-14465 05-29)
CSCL 03A

N74-14476* Max-Planck-Institut fuer Plasmaphysik, Munich (West Germany).
REPORT ON GAMMA-RAY ASTRONOMY RESULTS OBTAINED IN EUROPE SINCE THE IAU SYMPOSIUM NO. 55
K. Pinkau *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 133-137 refs (For availability see N74-14465 05-29)
CSCL 03A

N74-14483* Academy of Sciences (USSR), Moscow.
GAMMA-RAY ASTRONOMY AND COSMIC-RAY ORIGIN THEORY
V. L. Ginzburg *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 249-257 refs (For availability see N74-14465 05-29)
CSCL 03A

N74-14485* Rice Univ., Houston, Tex.
PROSPECTS FOR NUCLEAR-GAMMA-RAY ASTRONOMY
Donald D. Clayton *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 263-289 refs (For availability see N74-14465 05-29)
(Grant NSF GP-18335)
CSCL 03A

N74-14490* Paris Univ. (France).
MATTER-ANTIMATTER COSMOLOGY
R. Omnes *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 335-350 refs (For availability see N74-14465 05-29)
CSCL 03B

N74-14491* Observatoire de Paris-Meudon (France).
THE DEUTERIUM PUZZLE IN THE SYMMETRIC UNIVERSE
B. Leroy, J. P. Nicolle, and E. Schatzman *In* NASA. Goddard Space Flight Center Gamma-Ray Astrophys. 1973 p 351-359 refs (For availability see N74-14465 05-29)
CSCL 03B

N74-14494* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DISTORTION OF THE MICROWAVE BLACKBODY BACKGROUND RADIATION IMPLIED BY THE BARYON-SYMMETRIC COSMOLOGY OF OMNES AND THE GALAXY FORMATION THEORY OF STECKER AND PUGET
F. W. Stecker and J. L. Puget (Observatoire de Paris-Meudon) *In its* Gamma-Ray Astrophys. 1973 p 381-384 refs (For availability see N74-14465 05-29)
CSCL 03B

N74-14495* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PANEL DISCUSSION ON THE FUTURE DIRECTION OF GAMMA-RAY ASTRONOMY
Giovanni G. Fazio (Smithsonian Astrophysical Obs.), Carl Fichtel, Glenn Frye (Case Western Reserve), Kenneth Greisen (Cornell Univ.), Albert Metzger (JPL), Evry Schatzman (Paris Obs.), Floyd Stecker, and Jacob Trombka *In its* Gamma-Ray Astrophys. 1973 p 387-406 (For availability see N74-14465 05-29)
CSCL 03A

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N74-14529 Denver Univ., Colo.
A NONLINEAR PROGRAMMING ALGORITHM FOR THE AUTOMATED DESIGN AND OPTIMIZATION OF FLEXIBLE BOOSTER AUTOPILOTS Ph.D. Thesis
Francis David Hauser 1972 139 p
Avail: Univ. Microfilms Order No. 73-19909

A nonlinear programming technique has been developed for the automated design and optimization of autopilots for large flexible launch vehicles. This technique uses the iterative application of linear programming from some starting point to the final solution by solving successive linear programming problems. The method deals directly with the three main requirements of booster autopilot design to provide: (1) good response to guidance commands; (2) response to external disturbances to minimize structural bending moment loads and trajectory dispersions; and (3) stability with specified tolerances on the vehicles and flight control system parameters. The main design criteria are minimum gain/phase stability margins. The approach is to expand each rigid and flexible-body stability margin in a first order Taylor Series, to form a linear inequality constraint for each margin. Dissert. Abstr.

N74-14530*# Aerospace Corp., El Segundo, Calif. Systems Planning Div.
SPACE SHUTTLE/PAYLOAD INTERFACE ANALYSIS (STUDY 2.4). VOLUME 2: SPACE SHUTTLE TRAFFIC ANALYSIS Final Report
James A. Plough 31 Aug. 1973 112 p refs
(Contract NASw-2472)
(NASA-CR-136150; ATR-74(7334)-1-Vol-2) Avail: NTIS HC $7.75 CSCL 22B

The transfer is reported of the capability to perform capture/cost analyses to MSFC. Space shuttle performance and direct costs, tug characteristics, reliability, and cost data were provided by NASA. The launch vehicle, mission models, payloads, and computer programs are discussed along with capture/cost analysis, and cost estimates. For Vol. 1, see N74-12493. F.O.S.

N74-14531*# Scientific Translation Service, Santa Barbara, Calif.
SIMULATION OF THERMAL SYSTEMS OF A SPACE VEHICLE AND ITS ENVIRONMENT
L. V. Kozlov, M. D. Nusinov, and G. I. Petrov, ed. Washington NASA Nov. 1973 396 p refs Transl. into ENGLISH of the book "Modelirovaniye Teplovykh Rezhimov Kosmicheskogo Apparata i Okruzhayushchey ego Sredy" Moscow, Mashinostr., 1971 382 p
(Contract NASw-2035)
(NASA-TT-F-752) Avail: NTIS HC $8.00 CSCL 22B

The methods and equipment for simulating spacecraft thermal regimes in equipment on the Earth are discussed. The primary and secondary physical characteristics of space are distinguished, which can directly or indirectly affect the thermal condition of the spacecraft. The different methods of simulating thermal regimes which are studied in the book take into account the heat exchange between the spacecraft and the surrounding medium, and also the action of a vacuum, space radiation, and meteorites on the structural materials. A simulation technique is presented which uses vacuum chambers, radiant flux simulators, and different laboratory equipment. Author

N74-14532*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
SPACE SHUTTLE ATMOSPHERIC REVITALIZATION SUBSYSTEM/ACTIVE THERMAL CONTROL SUBSYSTEM COMPUTER PROGRAM (USERS MANUAL)
30 Aug. 1973 176 p
(Contract NAS9-12411)
(NASA-CR-134164; SP02T73) Avail: NTIS HC $11.00 CSCL

22B

A shuttle (ARS) atmosphere revitalization subsystem active thermal control subsystem (ATCS) performance routine was developed. This computer program is adapted from the Shuttle EC/LSS Design Computer Program. The program was upgraded in three noteworthy areas: (1) The functional ARS/ATCS schematic has been revised to accurately synthesize the shuttle baseline system definition. (2) The program logic has been improved to provide a more accurate prediction of the integrated ARS/ATCS system performance. Additionally, the logic has been expanded to model all components and thermal loads in the ARS/ATCS system. (3) The program is designed to be used on the NASA JSC crew system division's programmable calculator system. As written the new computer routine has an average running time of five minutes. The use of desk top type calculation equipment, and the rapid response of the program provides the NASA with an analytical tool for trade studies to refine the system definition, and for test support of the RSECS or integrated Shuttle ARS/ATCS test programs. Author

N74-14533*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FEASIBILITY OF SPACE DISPOSAL OF RADIOACTIVE NUCLEAR WASTE. 1: EXECUTIVE SUMMARY

Washington Dec. 1973 21 p

(NASA-TM-X-2911; E-7679) Avail: NTIS HC $2.75 CSCL 18G

This NASA study, performed at the request of the AEC, concludes that transporting radioactive waste (primarily long-lived isotopes) into space is feasible. Tentative solutions are presented for technical problems involving safe packaging. Launch systems (existing and planned), trajectories, potential hazards, and various destinations were evaluated. Solar system escape is possible and would have the advantage of ultimate removal of the radioactive waste from man's environment. Transportation costs would be low (comparable to less than a 5 percent increase in the cost of electricity) even though more than 100 space shuttle launches per year would be required by the year 2000. Author

N74-14534*# Martin Marietta Corp., Denver, Colo.

BALLOON LAUNCHED VIKING DECELERATOR TEST PROGRAM Summary Report

R. D. Moog and F. C. Michel Mar. 1973 81 p refs

(Contract NAS1-9000)

(NASA-CR-112288; TR-3720359) Avail: NTIS HC $6.25 CSCL 22B

Four BLDT flights were conducted during the summer of 1972. The purpose of these tests was to qualify the Viking parachute system behind the full-scale Viking entry vehicle over the maximum range of entry conditions anticipated in the Viking '75 soft landing on Mars. A summary of the test series is presented. Test conditions ranged from a Mach number of 2.0 to 0.5 and dynamic pressure from 11.7 to 4.4 psf. This range of conditions covers the uncertainty in entry conditions at Mars due to atmospheric and entry performance uncertainties. Emphasis is placed on parachute performance and simulated Mars entry vehicle motions as influenced by the parachute performance. Conclusions are presented regarding the ability of the parachute to perform within the operational parameters required for a successful soft Martian landing. A list of references which covers all reports in the qualification test program is included. Author

N74-14535*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT EVALUATION OF HL-10 LIFTING BODY HANDLING QUALITIES AT MACH NUMBERS FROM 0.30 TO 1.86

Robert W. Kempel and John A. Manke Washington Jan. 1974 47 p refs

(NASA-TN-D-7537; H-757) Avail: NTIS HC $3.00 CSCL 22C

The longitudinal and lateral-directional handling qualities of the HL-10 lifting body vehicle were evaluated in flight at Mach numbers up to 1.86 and altitudes up to approximately 27,450 meters (90,000 feet). In general, the vehicle's handling qualities were considered to be good. Approximately 91 percent of the pilot ratings were 3.5 or better, and 42.4 percent were 2.0. Handling qualities problems were encountered during the first flight due to problems with the control system and vehicle aerodynamics. Modifications of the flight vehicle corrected all deficiencies, and no other significant handling qualities problems were encountered. Author

N74-14536# European Space Research Organization, Paris (France).

STRUCTURAL AND THERMAL TESTS. THEIR EVOLUTION AND PRESENT TRENDS. VOLUME 1: STRUCTURAL AND MECHANICAL TESTS

Jun. 1973 511 p refs Partly in ENGLISH and partly in FRENCH Proc. of a Symp. held at Noordwijk, Neth., 4-7 Dec. 1972 3 Vol.

(ESRO-SP-95-Vol-1) Avail: NTIS HC $27.75

Problems in structural and mechanical testing, particularly as regards spacecraft structures, are discussed. Mechanical vibration and acoustic tests were compared for aircraft, spacecraft, missiles, and launch vehicle spacecraft configurations. Static testing methods for spacecraft structures were evaluated. Structural damping and shock resistance are discussed. Data acquisition and processing for vibration tests and photogrammetry are described. Mass distribution, spin testing, equilibration and spin reduction problems are treated. For individual titles, see N74-14537 through N74-14557.

N74-14537 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

REMARKS ON ESSENTIAL MODERN MODAL TEST METHODS

H. G. Natke *In* ESRO Struct. and Thermal Tests. Vol. 1 Jun. 1973 p 1-22 refs (For availability see N74-14536 05-31)

Some modern methods for ground vibration testing involving techniques which combine experiment with computation on electronic computers are discussed. The classical technique used to determine the modal characteristics of an elastomechanic system is the phase resonance method using multipoint excitation with appropriate forces in order to excite the structure in only one degree of freedom. This separation of degrees of freedom is particularly difficult when the eigenfrequencies of different components are closely adjacent. One solution is the phase separation method which fulfils most of the requirements, but work on this method is still in progress. ESRO

N74-14538 Societe Europeene d'Etudes et d'Essais d'Environnement, Buc (France).

BASIC STUDY OF UTILIZING MECHANICAL (SINUSOIDAL, RANDOM, SHOCK) OR ACOUSTIC TESTS [ETUDE DE PRINCIPE DE L'UTILISATION DES ESSAIS MECANIQUES (SINUSOIDAUX, ALEATOIRES, CHOCS) OU ACOUSTIQUES]

J. Gilly *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 23-40 ref In FRENCH (For availability see N74-14536 05-31)

Mechanical and acoustic ground tests for missiles were compared with regard to depreciation and the consequences of manufacturing imperfections. The objectives of the tests were to verify a theoretical study or to check the use of a material for a given application. The material tests led to a comparison of the environment specified for tests and the real environment in service. The possible merits of acoustic tests are pointed out. ESRO

N74-14539 Societe Nationale Industrielle Aerospatiale, Cannes (France).

ARE SINUSOIDAL VIBRATION TESTS REALISTIC? [LES ESSAIS AUX VIBRATIONS SINUSOIDALES SONT-ILS REALISTES?] c32

D. Auternaud *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 41-49 In FRENCH (For availability see N74-14536 05-31)

Sinusoidal vibration tests have been used for structural analysis. Their present importance and utility is discussed within the context of the evolution of computation methods and the perfectionism of technical means. A general philosophy has been adopted, and certain rules for the performing of tests and the exploitation of their results are presented. ESRO

N74-14540 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).

THE DIFFERENT ASPECTS IN TESTING AIRCRAFT STRUCTURES AND SPACECRAFT COMPONENTS ACOUSTICALLY

G. Bayerdoerfer *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 51-70 ref (For availability see N74-14536 05-31)

The problems in acoustic fatigue testing of aircraft and spacecraft structures are discussed. Due to the long lifespan for which aircraft structures must be designed, the acoustic fatigue problem was treated in a more sophisticated way compared with spacecraft components. It was shown that specific design methods against acoustic fatigue exist which permit estimation of the fatigue life. These design methods can be applied only tentatively to spacecraft components, as these structures are more complex and experience only a very short period of noise exposure. The components undergo a noise test covering the total time of high acoustic loading in a reverberation chamber. ESRO

N74-14541 GEC Turbine Generators, Leicester (England).

RESPONSE OF STRUCTURES TO SINE PLUS RANDOM NOISE EXCITATION c32

L. Yeh and I. Vesty *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 71-84 refs (For availability see N74-14536 05-31)

The response of structures under sine plus random noise excitation was investigated. The work was carried out in a high intensity acoustic facility. A complex structure with sine, random, and sine plus random excitations was applied. It was found that the superimposed technique could be used to estimate the response. ESRO

N74-14542 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

GROUND VIBRATION TESTS AND ESTIMATE OF LAUNCH VEHICLE POGO EFFECT [ESSAIS DE VIBRATION AU SOL ET PREVISION DE L'EFFET POGO DES LANCEURS]

R. Dat *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 85-102 refs In FRENCH; ENGLISH summary (For availability see N74-14536 05-31)

Ground vibration test methods for aircraft are not directly transferable to launch vehicles because the distribution of the excitation forces cannot be adapted to the sloshing modes of the liquid propellants. But it is shown that the transfer function measured with an unadapted excitation force can be used to determine the normal mode of the structure. The following testing possibilities are examined: a model, substructures separated from the complete structure, and the complete structure. ESRO

N74-14543 Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).

REAL LAUNCH VEHICLE FLIGHT LOADS AND THEIR SIMULATION FOR SPACECRAFT DEVELOPMENT

H. Oery and E. Hornung *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 103-136 (For availability see N74-14536 05-31)

A review of flight load calculations for launch vehicle/spacecraft structure combinations is presented. For the qualification and acceptance of a spacecraft and its structure, it is necessary to simulate not only quasistatic but also vibrational environments. Real periodic low frequency excitations (POGO and chugging) are usually known and are hardly influenced by spacecraft characteristics. Transient shock responses cannot be avoided. Sinusoidal shaker tests are not able to properly simulate transient vibration environments. Propert simulation can be given by static test and/or repeated load cycles (if applicable), as are usual in the aircraft industry. ESRO

N74-14544 Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).

TESTS FOR REALISTIC SIMULATION OF THE DYNAMIC FLIGHT ENVIRONMENT

H. G. Maager and H. Laube *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 137-161 refs (For availability see N74-14536 05-31)

Low, medium and high response levels to random vibration excitation of TD, Helios and Azur spacecraft models are presented as examples of unsatisfactory simulation of the local random vibration environment at equipment locations. The acoustic excited vibration environment is understood to be always combined with structure-borne vibration which is transmitted to the spacecraft via the mechanical spacecraft adaptor. Therefore acoustic and random vibration testing and vibro-acoustic testing are discussed. Concerning the sinusoidal tests, justification of the notching technique is generally accepted. Results of the dynamic flight load calculation of the Azur/Scout configurations are presented, indicating that in flight too, the vibration levels at the base of the spacecraft are essentially lower near the fundamental resonance of the rigidly mounted spacecraft. The difficulties in writing vibration specification for subsystems and components are discussed and methods of deriving vibration test levels which are not overconservative are suggested. The advantages and disadvantages of the shock spectrum presentation of the inflight shock environment are discussed. Author (ESRO)

N74-14545 Engins Matra, Velizy (France).

THE MECHANICAL ENVIRONMENT OF SATELLITE STRUCTURES AND LIGHTWEIGHT SOLAR PANELS [L'ENVIRONNEMENT MECANIQUE DES STRUCTURES DE SATELLITE ET DES PANNEAUX SOLAIRES LEGERS]

H. Larsson *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 163-177 refs In FRENCH (For availability see N74-14536 05-31)

The problems in simulating the mechanical environment of satellite structures are discussed. Two test methods were examined; shaker tests and acoustic tests. Their advantages with respect to the frequency domains chosen for the performance of tests on lightweight solar panels are evaluated. ESRO

N74-14546 National Aerospace Lab., Amsterdam (Netherlands).

TWO EXAMPLES OF LOADING SYSTEMS FOR STATIC RIG TESTS ON SATELLITE STRUCTURES

P. J. Sevenhuijsen *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 179-206 (For availability see N74-14536 05-31)

The static method of testing spacecraft structures in a rig is described and two examples are presented. For the static method, the structure is provided with loading brackets mounted at the locations of the instruments. On these loading brackets point loads are applied by means of a whiffle-tree system. One example is the loading system for static tests on the Intelsat-3 structure. The other example is the loading system for static tests on the Astronomical Netherlands Satellite (ANS) structure. The purpose of the static tests on the Intelsat-3 structure was to obtain experimental data which could be compared with data from finite element calculations. The static test on the ANS structure was a typical strength test. The special features of both systems are discussed and illustrated. ESRO

N74-14547 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

COMPARISON OF STATIC LOAD TEST VERSUS CENTRIFUGAL AND SPIN TESTS

K. Radimirsh *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 207-223 (For availability see N74-14536 05-31)

Two methods of static load tests for satellite structures are discussed: (1). In the static load test, the normal occurring inertia loads are replaced by tensile forces which are distributed via whiffle trees to the points of application. (2). In the centrifugal test, the satellite model is mounted horizontally, via a rigid test adapter, on the end of the rotation arm of a centrifuge. During rotation each of the components exerts an axial force proportional to its mass. Which of the two methods is preferred depends on the predominant loading, the dimensions, and the complexity of the satellite structure. E.g. for the GEOS satellite structure the static load test was advantageous, whereas parts of Aeros satellite structure were tested by static loading but, for qualification, a centrifugal test and a spin test were performed. ESRO

N74-14548 Compagnia Industriale Aerospaziale S.p.A., Rome (Italy).

TEST CRITERIA AND RESULTS ON SIRIO SATELLITE MECHANICAL MODEL

G. M. Cremona *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 225-251 (For availability see N74-14536 05-31)

The whole sequence of tests performed on the Sirio satellite mechanical model, together with the technical and programmatic reasons for choosing the above sequence, are briefly

presented. The investigation performed to determine the vibration modes (shape and natural frequencies), and the vibration tests, are described. Problems connected with the spurious inputs during mono-axial vibration tests are analyzed in relation to satellite configuration and test facility performances. A comparison was made between the test and computerized finite element analysis. ESRO

N74-14549 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
THE AEROS SATELLITE: AN EXAMPLE OF A DAMPED STRUCTURE
H. Rieger *In* ESRO Struct. and Thermal Tests. Vol. 1 Jun. 1973 p 253-275 (For availability see N74-14536 05-31)

The Aeros structure will be used to show how special damping elements may be used in a spacecraft and how the dynamic response is affected. The structural concept of the Aeros is characterized by a central primary structure and an outer case. The central structure consists of a cylindrical adapter, three radically arranged cantilever beams and the equipment mounting panels attached to them. Three of the five experiments, including a mass spectrometer, are mounted to the outer case. To minimize the outgassing rate and for electrical and thermal reasons, the outer case was designed as a gasproof welded-steel case. This construction being relatively heavy, the central and the outer structures were designed to combine strength with ease of manufacture. The analysis methods and the tests applied to optimize the dynamic behavior are presented. Using relatively simple dynamic models in the beginning of the development, many trade off studies could be performed in a short time. For example, the optimization of amplification factors of central and outer structure by varying the parameters of the spring/damping elements is shown. Advantages and problems arising from the use of damping elements are discussed. The suitability of damped structures is discussed by comparing the Scout and the Thor Delta launcher vibration environments. Author (ESRO)

N74-14550 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
SYNTHESIS OF MECHANICAL SHOCKS BASED ON THE SHOCK SPECTRUM CONCEPT
K. Muehlbauer *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 277-302 refs (For availability see N74-14536 05-31)

Some aspects of simulation of mechanical shocks by means of shock synthesis techniques are considered. A brief survey of the principles and methods of shock synthesis is given. The effects of shock synthesis are discussed on the basis of the shock spectrum of a typical synthesized shock. Special emphasis is put on the holes between the discrete exciting frequencies, on the influence of the damping present in the test specimen, and on the distribution of response amplitudes. Using an experimental result from a spacecraft separation test as an example, the criterion for the application of shock synthesis is demonstrated. The measured shock turns out to be distinctly oscillatory and, with respect to the characteristics investigated, better simulated by shock synthesis than by shock pulse. An improved mode of excitation is proposed. By applying a hyperbolic sweep instead of sinusoidal burst of graduated frequencies, the unrealistic holes in the spectrum are eliminated. Advantages can be expected from taking into account damping and fatigue effects. Author (ESRO)

N74-14551 Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrt Konstruktionen.
DATA ACQUISITION AND REDUCTION IN VIBRATION EXPERIMENTS c32
J. A. Agyris, W. Aicher, and K. Eberle *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 303-331 (For availability see N74-14536 05-31)

Problems of data handling with vibration testing are described; the measurement of the damping of light-weight structures with fairly different characteristics serves as an example. A time shared computer controls the experiment and produces a graphic output. A block diagram of the test set-up and flow diagrams containing hardware and software elements are given for the discussion of some problems. The main considerations are accuracy of results and easy checking of the experiment. The principles, devices, and programs described may be used to solve many other iteration measuring problems as well. Author (ESRO)

N74-14552 Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrt Konstruktionen.
MEASUREMENT OF THREE DIMENSIONAL DEFORMATIONS VIA PHOTOGRAMMETRIC METHODS AND ELECTRONIC DATA PROCESSING
J. H. Agyris, M. Kirschstein, and M. Mueller *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 333-379 refs (For availability see N74-14536 05-31)

A method for measuring positions and deformations without mechanical contact was developed from close distance photogrammetry. The quick, simple, and cheap applicability of the process is especially emphasized. The mathematical derivations are presented in matrix form so as to be easily handled with a digital computer. Since the attainable accuracy is dependent to a high degree on the identification of the points to be measured, special marks were developed. ESRO

N74-14553 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
METHODS AND RESULTS OF MEASURING THE MASS PROPERTIES OF THE HELIOS AND AEROS SATELLITES
H. E. Schneider *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 381392 (For availability see N74-14536 05-31)

The purpose of mass property determination is discussed, and the different types of tests are presented as follows: mass determination center of gravity determination and balancing and determination of inertia (in particular, the balancing of the Aeros satellite). Methods of measurement, calculation, and calibration are described. The advantages of the equipment used are described in detail. Some characteristic test set-ups, the measurements made, and the results gained are presented. The problems and difficulties of handling are shown and suggestions for further use discussed. ESRO

N74-14554 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
METHODS AND RESULTS OF SIMPLE SPIN TESTING OF THE AEROS AND HELIOS SATELLITES
H. E. Schneider *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 393-403 (For availability see N74-14536 05-31)

The aim was to simulate the load of centrifugal and torsional or twisting forces caused by the spin-up and rotation of the last stage of the carrier vehicle. Tests were carried out with a spin table, where the torsional load (angular acceleration) of the spin up was simulated by deceleration from a specified rotation to a halt in a given time, i.e. the test specimen was rotating with the spin of the last stage, but in the opposite direction, and was stopped by a calibrated hydraulic disk brake in the same time as the real spin-up takes. The Aeros spin test also included the functional testing of experiment cover, i.e. they were jettisoned at 10 RPM. The spin test of Helios S1 also included an additional special test. This was the eccentric spin test on the reflector, called a quasistatic acceleration test. The reflector was mounted eccentrically on the spin table and loaded with centrifugal forces up to 20 g in lateral direction. Author (ESRO)

N74-14555 Consortium Franco Allemand pour le Satellite Symphonie (CIFAS), Les Mureaux (France).
INFLUENCE OF AERODYNAMIC FORCES ON THE DYNAMIC EQUILIBRATION OF STRUCTURES [L'INFLUENCE DES FORCES AERODYNAMIQUES SUR L'EQUILIBRAGE DYNAMIQUE DES STRUCTURES]
E. Schober and Z. Zewen *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 405-451 In FRENCH (For availability see N74-14536 05-31)

The dynamic equilibration of structures subjected to aerodynamic forces is discussed. Aerodynamic forces perturb the precision of the equilibration by exerting steady and unsteady forces and producing an elastic deformation of the structure. Four possible means of eliminating the aerodynamic effects are proposed and exemplified by tests with the mechanical model of the Symphonie satellite. ESRO

N74-14556# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).
DEVELOPMENT AND QUALIFICATION DEPLOYMENT TESTS OF HELIOS MAGNETOMETER BOOMS IN AIR
E. Winkelhoff and A. Freiheit *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 453-478 (For availability see N74-14536 05-31)

Extensive development tests are described for Helios solar probe magnetometer sensors supported by booms. Mechanisms were developed and deployments in air under various energy conditions were performed. Details concerning mechanisms, such as a viscous damper with spool and cord, hinge assemblies, release and locking devices, kick-off springs, etc. are given. The problems of testing in air are described, e.g. decrease in spin rate due to air drag, and influence of additional fins. Test results are discussed. The qualification program is shown, and the acceptance criteria are defined. ESRO

N74-14557 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
QUALIFICATION TESTS OF A ROTATIONAL SPEED REDUCTION MECHANISM FOR THE AEROS SATELLITE [ESSAIS DE QUALIFICATION D'UN MECANISME POUR LA REDUCTION DE LA VITESSE DE ROTATION DU SATELLITE AEROS]
R. Strittmatter *In* ESRO Struct. and Thermal Tests. Vol. 1 Jun. 1973 p 479-493 In FRENCH (For availability see N74-14536 05-31)

A mechanism based on the yo-yo principle was developed in order to reduce the rotational speed of the German research satellite Aeros. The main effort was extended to the qualification test program concerning either the components or the system. The results obtained are discussed. The conclusion is that, besides the calculated program definition a check on reliability by means of a test program is indispensable. ESRO

N74-14558# European Space Research Organization, Paris (France).
STRUCTURAL AND THERMAL TESTS. THEIR EVOLUTION AND PRESENT TRENDS. VOLUME 2: GENERAL SUBJECTS
Jun. 1973 118 p refs Partly in ENGLISH and partly in FRENCH Proc. of a Symp. held at Noordwijk, Neth., 4-7 Dec. 1972 3 Vol.
(ESRO-SP-95-Vol-2) Avail: NTIS HC $8.00

The isolated subsystem/discipline and how the main objective of quality, reliability, and testing can be connected to a fundamental common concept, and the failure mechanism related to system success were discussed. The environmental conditions to which a satellite is exposed during the launch phase were surveyed, and possibilities of studying and checking this environment during a qualification flight are detailed. A development and test plan tailored for the particular characteristics of the HELOS satellite is described. For individual titles, see N74-14559 through N74-14562.

N74-14559 European Space Research and Technology Center, Noordwijk (Netherlands). Communications Systems Div.
QUALITY, RELIABILITY AND TESTING: AN INTEGRATED CONCEPT
T. A. Meaker *In* ESRO Struct. and Thermal Tests, Vol. 2 Jun. 1973 p 1-21 refs (For availability see N74-14558 05-31)

The fallacy of the isolated subsystem/discipline and how the main objectives of quality, reliability, and testing can be connected to a fundamental common concept, and the failure mechanism related to system success, are discussed. The similarity of data collection and analysis limitations, or test design techniques, is briefly mentioned. Author (ESRO)

N74-14560 European Space Research and Technology Center, Noordwijk (Netherlands).
MECHANICAL AND THERMAL ENVIRONMENTS ENCOUNTERED BY A SATELLITE DURING THE LAUNCHING PHASE, AND PARAMETERS TO BE MEASURED DURING A QUALIFICATION FLIGHT USING A TECHNOLOGICAL CAPSULE [ENVIRONNEMENTS MECANIQUES ET THERMIQUES RENCONTRES PAR UN SATELLITE PENDANT LA PHASE DE LANCEMENT ET PARAMETRES A MESURER AU COURS D'UN VOL DE QUALIFICATION A L'AIDE D'UNE CAPSULE TECHNOLOGIQUE]
R. L. Mory and M. Nerault *In* ESRO Struct. and Thermal Tests, Vol. 2 Jun. 1973 p 23-33 In FRENCH (For availability see N74-14558 05-31)

The environmental conditions to which a satellite is exposed during the launch phase are discussed, and possibilities of studying and checking this environment during a qualification flight using a technological capsule are surveyed. The conditions discussed are the following: mechanical and thermal environments, contamination, and kinematic conditions at the moment of satellite/launcher separation. ESRO

N74-14561 European Space Research and Technology Center, Noordwijk (Netherlands).
ENVIRONMENTAL TESTS FOR DEVELOPMENT, QUALIFICATION AND ACCEPTANCE OF SATELLITES
C. B. VonStieglitz *In* ESRO Struct. and Thermal Tests, Vol. 2 Jun. 1973 p 35-53 (For availability see N74-14558 05-31)

The objectives for development, qualification, and acceptance of satellites are summarized, and the respective consequences for planning are shown. A comparison of these plans with actual programs reveals discrepancies. Priorities in objectives are established, in order to have a rational basis for compromises and to identify activities which do not significantly contribute to the success of a program or do not require a flight standard satellite. ESRO

N74-14562 European Space Research and Technology Center, Noordwijk (Netherlands).
HELOS DEVELOPMENT, ASSEMBLY, INTEGRATION AND TEST PLAN
R. Cosaert and R. Amartin *In* ESRO Struct. and Thermal Tests, Vol. 2 Jun. 1973 p 55-113 refs (For availability see N74-14558 05-31)

A development and test plan tailored for the Helos satellite is described. The HELOS concept was designed in a cost conscious background, and the development test plan was also derived. The main principle is to shorten the development phase within a conservative low risk sequence of tests. Cost savings on the integration and testing itself is not the objective, but, rather, the reduction of the overall cost, which is considerably influenced by the development and test plan. This plan is characterized by the elimination of a prototype model phase and the use of a sufficient number of structures dedicated to groups of subsystems in the subsystem/segment assemblies. The latter is aimed at isolating problems during test so that the active integration team is not immobilized by difficulties encountered in individual subsystems. The potential for dynamic planning, combined with performance incentive contracts, is illustrated. Author (ESRO)

N74-14563# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
EXPERIMENTS IN SMALL ROCKET DEPLOYMENT OF 1000 FOOT LONG ELECTRICALLY CONDUCTING FILAMENTS
Charles B. Kalakowsky, Roger W. Whidden, and Edward A. Lewis 10 Jul. 1973 19 p refs
(AD-767588; AFCRL-TR-73-0408; AFCRL-IP-194) Avail: NTIS CSCL 22/2

A method of rapidly deploying long, electrically conducting filaments of metallized mylar in the air at selected altitudes was designed and tested to a limited extent. The mylar, specially wound in tight rolls, is loaded into small rocket pods and pyrotechnically ejected at predetermined altitudes. Aerodynamic forces decelerate the rolls and cause them to unfuel rapidly. The technique is intended for use in evaluating and possibly reducing lightning hazards to aerospace vehicles. Author (GRA)

N74-14564# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE SIMULATION AND ANALYSIS OF A NEW FIRE CONTROL TECHNIQUE FOR LAUNCHING AIR-TO-AIR MISSILES M.S. Thesis
Lee Duane Puckett and Cecil David Haas Jun. 1973 122 p refs
(AD-768353; GGC/EE/73-4) Avail: NTIS CSCL 16/4

Under controlled conditions the air-to-air missile has proven to be an effective weapon. However, this situation changes in

the area of hard maneuvering combat where the missile system must perform under more taxing conditions. Techniques to remedy the deficiencies found in current systems range from hardware improvements to computerized methods for predicting missile firing opportunties. The study considers a fire control technique which predicts and displays a missile's maximum off-boresight capability and, in addition, allows the seeker to acquire non-boresight targets. The fire control computer considers such factors as the target's acceleration and range and the missile's performance. The philosophy of this approach is to reduce both the hardware and on-line computational requirements while incorporating pilot judgment as part of the solution to the fire control problem. (Modified author abstract) GRA

N74-14565# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
MISSILE, GUIDED, ANTITANK Final Report
Ray Rush 9 Jan. 1973 25 p refs
(AD-757809; TOP-5-3-057) Avail: NTIS CSCL 16/4

The report describes a method for evaluation of antitank guided missile operational and functional performance characteristics. It identifies facilities and equipment required. It provides procedures for operational suitability, suitability of mounts, reliability, durability, maintainability, and value analysis. (Modified author abstract) GRA

N74-14566# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE MAGNUS EFFECT ON A GREATLY ELONGATED FINNED ROTATING BODY AT M EQUALS 4
N. M. Bychkov, B. L. Dubrovskiy, and V. M. Kovalenko 18 Sep. 1973 14 p refs Transl. into ENGLISH from Izv Sibirsk. Otd. Nauk SSSR (Novosibirsk), no 13, 1972 p 24-28
(AF Proj. G101)
(AD-767941; FTD-HT-23-32-74) Avail: NTIS CSCL 16/2

During the flight of a rotating missile or rocket under an angle of attack aerodynamic forces develop which are directed normal to the plane of the angle of attack, i.e., the so-called Magnus effect is displayed. The presence of lateral forces leads to the deviation of the missile from the assigned direction. For the calculation of flight trajectory it is necessary to know the magnitude of Magnus force and the point of its application. The report presents experimental data relative to the Magnus effect. GRA

N74-14567# Army Missile Command, Redstone Arsenal, Ala. Aeroballistics Directorate.
RESULTS OF A TRANSONIC WIND TUNNEL INVESTIGATION OF THRUST EFFECTS ON THE AERODYNAMICS OF FOUR LONGITUDINALLY-SUPPORTED RINGTAIL MISSILE CONFIGURATIONS
J. H. Henderson Oct. 1973 94 p refs
(DA Proj. 1M2-62303-A-214)
(AD-768158; RD-73-15) Avail: NTIS CSCL 19/1

Transonic wind tunnel tests were conducted on a strut-supported model to determine thrust effects on four longitudinal strut supported ringtail configurations. The configurations were achieved by varying the distance between the nozzle exit plane and the ringtail. Thrust was simulated by cold air and was varied from 0 to 400 pounds. Of primary interest, was the effect of thrust level and longitudinal position of the nozzle exit plane on missile stability. For the thrust levels tested, a favorable effect on longitudinal stability was experienced on the configuration with the nozzle exit plane located at the ringtail leading edge. The test was conducted at the Calspan Corporation's 8 foot Transonic Wind Tunnel at Mach numbers ranging from 0.4 to 1.2. Angles of attack were from -5 degrees to -6 degrees at a sideslip angle of 0 degrees. Thrust, from 0 to 400 pounds, was the only varying parameter. Author (GRA)

N74-14568# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
TROPIC ENVIRONMENTAL TEST OF MISSILE AND ROCKET SYSTEMS Final Report
3 Apr. 1973 19 p refs
(AD-768009; TOP-5-1-032) Avail: NTIS CSCL 16/4

The report provides background information relative to test and evaluation of missile and rocket systems. It identifies supporting tests, facilities and equipment required. It discusses conduct of test, test data, and analysis procedures. It is applicable to storage and field test in wet-warm and wet-hot climatic categories, and excludes simulated environments. (Modified author abstract) GRA

N74-14673 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 6: AEROSPACE PHYSICS, SPACE SIMULATION, AEROSPACE MEDICINE [FACHGEBIET 6: FLUG-RAUMPHYSIK RAUMSIMULATION, FLUGMEDIZIN]
In its DFVLR Annual Review, 1972 1972 p 317-350 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

N74-14676 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
RESEARCH IN CHEMICAL ROCKET PROPULSION, SATELLITE ELECTRONICS, AND SPACECRAFT COMMUNICATIONS [BEREICH FUER RAUMFLUGPROJEKTE]
In its DFVLR Annual Review, 1972 1972 p 403-436 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N74-14569 Lehigh Univ., Bethlehem, Pa.
AN IMPROVED EXCEEDANCE THEORY FOR COMBINED RANDOM STRESSES WITH APPLICATION TO AIRCRAFT GUST RESPONSE Ph.D. Thesis
Harold C. Lester 1973 210 p
Avail: Univ. Microfilms Order No. 73-23809

The general n-dimensional theory for calculating the average number of times per second that a random stress vector crosses an interaction boundary is developed. This represents an extension of Rice's classic solution for the exceedances of a constant level by a single random process to its counterpart for an n-dimensional random vector process. In the extension n jointly-stationary random processes forming the components of an n-dimensional stress vector are considered. A stress interaction boundary is assumed in the form of a closed surface imbedded in this n-dimensional stress space. The theory for the number of exceedances of an arbitrary stress interaction boundary is presented using a joint-statistical approach which fully accounts for all cross-correlation effects and leads to a closed-form expression for the exceedance density function. Dissert. Abstr.

N74-14570 Engineering Sciences Data Unit, London (England).
GEOMETRIC STRESS CONCENTRATIONS, TWO EQUAL UNREINFORCED CIRCULAR HOLES IN INFINITE FLAT PLATES
Jun. 1967 12 p ref Sponsored by Roy. Aeron. Soc.
(ESDU-67023) Copyright. Avail: Issuing Activity

A procedure for determining the geometric stress concentrations of two equal reinforced circular holes in infinite flat plates is presented. A drawing of a typical specimen is provided. The mathematical analysis of the problem is presented. Data for various configurations of test specimens are presented in graph form. Author

N74-14571 Engineering Sciences Data Unit, London (England).
BUCKLING LOADS IN SHEAR OF FLAT SANDWICH PANELS. ISOTROPIC FACE PLATES AND ORTHOTROPIC CORES OF ZERO FLEXURAL STIFFNESS, ALL EDGES SIMPLY-SUPPORTED
Apr. 1967 4 p refs
(ESDU-67024) Copyright. Avail: Issuing Activity

Curves are presented for determining the buckling modes of simply-supported sandwich panels having isotropic face plates and orthotropic cores of zero flexural stiffness, stressed in the elastic range. Author

N74-14572 Engineering Sciences Data Unit, London (England).
BUCKLING LOADS UNDER COMBINED LONGITUDINAL AND TRANSVERSE DIRECT STRESS OF FLAT SANDWICH PANELS ISOTROPIC FACE PLATES AND ORTHOTROPIC CORES OF ZERO FLEXURAL STIFFNESS, ALL EDGES SIMPLY-SUPPORTED
Jun. 1967 21 p refs Supersedes ESDU-Struct-07.01.01 Sponsored by Roy. Aeron. Soc.
(ESDU-67025; ESDU-Struct-07.01.01) Copyright. Avail: Issuing Activity

Graphs are presented for finding the buckling loads of simply-supported sandwich panels having isotropic face plates and orthotropic cores of zero flexural stiffness, stressed in the elastic range. Author

N74-14573 Cincinnati Univ., Ohio.
CRACK TIP STRAIN FIELDS AND FRACTURE IN LAMINATES OF 350 GRADE MARAGING STEEL AND TYPE 304 AUSTENITIC STAINLESS STEEL Ph.D. Thesis
John Thomas Cammett 1973 196 p
Avail: Univ. Microfilms Order No. 73-22752

An experimental study was performed on crack tip strain fields and fracture resistance of a 350 ksi grade maraging steel and crack-arrester oriented laminates of the maraging steel and AISI type 304 stainless steel. The ductile stainless steel lamination was intended to provide a tough energy absorbing layer to mitigate against crack extension and thereby increase fracture resistance without marked strength loss relative to the maraging steel. The laminates were prepared by vacuum hot pressing to form diffusion bonds between sheets and plates of the two materials. Resulting bond tensile strength was greater than the ultimate strength of the stainless steel. Single edge notch and double edge notch specimens were prepared from both materials individually and from laminates having dubtile laminate strip widths in the range of 0.015 to 0.115 in. All specimens were precracked by fatigue cycling prior to observation of the crack tip strain fields.
Dissert. Abstr.

N74-14574 Pennsylvania Univ., Philadelphia.
FORCED NONLINEAR LIBRATIONS OF SAGGED CABLES Ph.D. Thesis
Syed Amjad Ali 1973 267 p
Avail: Univ. Microfilms Order No. 73-24109

The time history of the three components of the displacements and tension in a single sagged cable subjected to the following forcing functions: (1) a suddenly applied uniform load constant with time, (2) a load varying sinusoidally with time, (3) a dynamic load representing a given wind input data, prescribed time history of motion of one end of cable are discussed. The equations of motion of the cable are developed for the general case when the cable is supported at two different elevations and subjected to spatial static and dynamic loads between supports. The nonlinear strain displacement relationship is used, which accounts for the change in cable tension during motion. The problem defined above is governed by three nonlinear coupled partial differential equations. The equations are solved using finite difference method for the case when the cable is subjected to static loads and dynamic loads for the fixed and elastic support conditions. Dissert. Abstr.

N74-14575 Utah Univ., Salt Lake City.
APPLIED ADHESIVE FRACTURE MECHANICS Ph.D. Thesis
Garron Perry Anderson 1973 163 p
Avail: Univ. Microfilms Order No. 73-23108

Since most adhesive systems are not amenable to analytical solution, this treatise demonstrates techniques whereby the parameters (energy release rate or stress intensity factor) necessary for applying an energy balance technique to adhesive systems may be obtained numerically. The procedures basically follow those developed for applying finite element analyses to cohesive fracture systems. However, in many stress systems, stress oscillations near the point of debonding have been shown, both analytically and numerically, to occur. The numerical oscillations are particularly noticeable for linear displacement compatible elements, high Poisson's ratios, and highly constrained systems. This treatise discusses the effect of these oscillations upon the calculation of the stresses and strain energy, and demonstrates that in this potentially difficult problem, finite element codes can be used with sufficient precision for fracture analysis.
Dissert. Abstr.

N74-14576 New Mexico State Univ., University Park.
THE EFFECT OF SHEAR FLEXIBILITY AND ROTATORY INERTIA ON THE ELASTIC DEFLECTION OF UNIFORM BEAMS UNDER TRANSVERSE IMPACT LOADINGS Ph.D. Thesis
Shripati Narain Dubey 1973 106 p
Avail: Univ. Microfilms Order No. 73-22617

The Timoshenko Equation for a simple beam with arbitrary initial conditions and/or loading is solved using both finite transform and finite difference methods. The derivation of the finite transform is based on Sturm-Liouville theory. The finite difference recurrence formula is developed using central difference operators. Five examples are considered and the numerical result of the exact finite transform method and the approximate finite difference method are tabulated and also compared to the Rayleigh equation. Specific recommendations are made with regard to the utility of each approach and the restrictions in their use is noted. Dissert. Abstr.

N74-14577 Pittsburgh Univ., Pa.
A STUDY OF CONCENTRATED MOMENTS APPLIED TO THIN ANNULAR PLATES Ph.D. Thesis
John Martin Thompson 1973 133 p
Avail: Univ. Microfilms Order No. 73-24100

Equations to determine the deflection in annular plates with either fixed or simply-supported boundary due to the action of a single concentrated moment have been developed. The applied concentrated moment is expressed in terms of a Fourier Series and applied to the plate at an arbitrary radius. The plate is separated into two parts along this radius and the solution is applied to each part with the appropriate boundary condition. These boundary conditions include the condition at the outside of the plate, the condition at the inside of the plate and the condition at the applied load radius, namely, the deflection and the slopes must be the same for both parts of the plate and the shearing force and bending moment must be continuous across this radius. Dissert. Abstr.

N74-14578 Cincinnati Univ., Ohio.
RAYLEIGH WAVE INTERACTION WITH A GROWING FATIGUE CRACK Ph.D. Thesis
Alan William Lohanick 1973 127 p
Avail: Univ. Microfilms Order No. 73-24416

Rayleigh (surface) waves having frequencies between 2 and 18 MHz are launched across the surface of an aluminum fatigue specimen, and pass a stress concentrator at which fatigue cracks grow favorably. The surface waves are produced by a polystyrene wedge transducer containing a 2 MHz x-cut quartz transducer element, and are detected by a similar wedge after passing the stress concentrator and the fatigue crack. The received signal strength is measured directly in decibels (db) at each stage of crack growth and the attenuation due to the fatigue crack is calculated for each of the frequencies (2, 6,10, 14 and 18 MHz) as a function of crack size. The attenuation results are related to results calculated from two simple scattering models, and found to agree with the models to within limits imposed by a lack of knowledge of wavefront shape. Dissert. Abstr.

N74-14579 Carnegie-Mellon Univ., Pittsburgh, Pa.
A STUDY OF FRACTURE PHENOMENA IN FIBER COMPOSITE LAMINATES Ph.D. Thesis
Harold John Konish, Jr. 1973 120 p
Avail: Univ. Microfilms Order No. 73-22871

The extension of linear elastic fracture mechanics from ostensibly homogeneous isotropic metallic alloys to heterogeneous anisotropic advanced fiber composites is considered. It is analytically demonstrated that the effects of material anisotropy do not alter the principal characteristics exhibited by a crack in

an isotropic material. The heterogeneity of fiber composites is experimentally shown to have a negligible effect on the behavior of a sufficiently long crack. A method is proposed for predicting the fracture strengths of a large class of composite laminates.
Dissert. Abstr.

N74-14580# Aeronautical Research Labs., Melbourne (Australia).
RESIDUAL STRENGTH OF CRACKED PANELS UNDER SHEAR FORCES
R. Ellis May 1973 40 p refs
(ARL/SM-Note-393) Avail: NTIS HC $4.00

The residual strength of aluminum alloy panels with central cracks subjected to shear forces was investigated. Photographic methods were used to determine the load at which a crack started to extend, and the direction of the extension. In all cases, crack propagation occurred in the presence of panel buckling. Data obtained from electrical resistance strain gages confirm the observation. An empirical relationship was developed to account for the effects of buckling on the crack propagation.
Author

N74-14581# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE LINEAR THEORY OF SHELLS AND ITS APPLICATION TO INELASTIC CALCULATIONS
Roger Valid Oct. 1973 149 p refs In FRENCH; ENGLISH summary
(ONERA-Publ-147) Avail: NTIS HC $9.50

The linearized theory of thin shells is applied to the case of large displacements and large deformations out of the elastic range, with or without transverse shear strain. The equilibrium is written by means of the virtual displacements principle, from the three-dimensional formulation and from kinematic hypotheses, in particular for the thickness variation. This classical method is set down with a new geometrical formulation which makes easy the study of compatibility of the linear generalized deformations as well as that of the generalized stress functions. The conditions of closure relative to these two problems are written also on the boundaries in the case of multiconnex shells. These questions are then treated again and associated by use of variational methods. Some considerations are given concerning the numerical incremental resolution, in particular by the finite element method. The linearized direct and complementary energy methods also are described.
Author

N74-14582# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
EXPERIMENTAL DETERMINATION OF THE VIBRATORY CHARACTERISTICS OF STRUCTURES
Christian Beatrix 1973 33 p refs In FRENCH; ENGLISH summary
(ONERA-TN-212) Avail: NTIS HC $3.75

Constant progress in testing means led to repeated reorganizations of the experimental procedures, with the acquisition and reduction of a maximum number of structural data within the minimum time as a permanent objective. A few types of anomalies inherent to mechanical structures, encountered during the last two years of exploitation, and the solutions adopted to remedy them are given.
Author

N74-14583*# Kanner (Leo) Associates, Redwood City, Calif.
STRENGTH OF THIN INTERMEDIATE LAYERS
L. A. Zabashta, V. P. Minakov, N. D. Rybalchenko, and A. S. Tron Washington NASA Dec. 1973 10 p refs Transl. into ENGLISH from Probl. Prochnosti (USSR), v. 4, Oct. 1972 p 111-115
(Contract NASw-2481)
(NASA-TT-F-15216) Avail: NTIS HC $3.00 CSCL 20K

The mechanical properties of thin ferrosilicon layers sandwiched between plates of a high-strength martensitic steel and between plates of a mild steel are studied at temperatures ranging between 20 and 1000 C, using cylindrical samples. The tensile strength of the samples is plotted vs. the relative thickness of the ferrosilicon layer.
Author

N74-14584*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THREE-DIMENSIONAL ELASTIC STRESS AND DISPLACEMENT ANALYSIS OF FINITE GEOMETRY SOLIDS CONTAINING CRACKS
John P. Gyekenyesi and Alexander Mendelson 1974 40 p refs Proposed for presentation at 7th US Natl. Congr. of Applied Mechanics, Boulder, Colo., 3-7 Jun. 1974; sponsored by US Natl. Comm. of Theoret. and Applied Mechanics of the Natl. Acad. of Sci. Submitted for publication
(NASA-TM-X-71467; E-7170) Avail: NTIS HC $4.00 CSCL 20K

The line method of analysis is applied to the Navier-Cauchy equations of elastic equilibrium to calculate the displacement distributions in various bodies containing cracks. The application of this method to these equations leads to coupled sets of simultaneous ordinary differential equations whose solutions are obtained along sets of lines in a discretized region. When decoupling the equations and their boundary conditions is not possible, the use of a successive approximation procedure permits the analytical solution of the resulting ordinary differential equations. The results obtained show a considerable potential for using this method in the three-dimensional analysis of finite geometry solids and suggest a possible extension of this technique to nonlinear material behavior.
Author

N74-14585*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONLINEAR RESPONSE OF BORON/ALUMINUM ANGLEPLIED LAMINATES UNDER CYCLIC TENSILE LOADING: CONTRIBUTING MECHANISMS AND THEIR EFFECTS
C. C. Chamis and T. L. Sullivan 1973 27 p refs Presented at Symp. on Fatigue of Composite Mater., Bal Harbour, Fla., 3-4 Dec. 1973; sponsored by Am. Soc. for Testing and Mater.
(NASA-TM-X-71490) Avail: NTIS HC $3.50 CSCL 20K

The nonlinear response of boron/aluminum angleplied laminates subjected to cyclic loads was investigated. A procedure is outlined and criteria are proposed which can be used to assess the nonlinear response. The procedure consists of testing strategically selected laminate configurations and analyzing the results using composite mechanics. Results from the investigation show the contributions to nonlinear behavior are from: premature random fiber breaks where the ply orientation angle is small relative to the load direction, ply relative rotation at intermediate values of the ply orientation angle, and nonlinear aluminum matrix behavior at large values of the orientation angle. Premature fiber breaks result in progressively more compliant material; large ply relative rotations result in progressively stiffer material; and pronounced matrix nonlinear behavior results in no significant change in the stiffness of the initial load portion.
Author

N74-14586*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASTRAN: USERS' EXPERIENCES
Washington Sep. 1973 741 p refs Presented at the 3d NASTRAN Users' Colloq., Hampton, Va., 11-12 Sep. 1973
(NASA-TM-X-2893; L-9220) Avail: NTIS HC $14.75 CSCL 20K

The proceedings of a conference on NASA Structural Analysis (NASTRAN) to analyze the experiences of users of the program are presented. The subjects discussed include the following: (1) statics and buckling, (2) vibrations and dynamics, (3) substructing, (4) new capability, (5) user's experience, and (6) system experience. Specific applications of NASTRAN to spacecraft, aircraft, nuclear power plants, and materials tests are reported. For individual titles, see N74-14587 through N74-14624.

N74-14587* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FUTURE NSMO PLANS FOR MAINTENANCE OF NASTRAN
Deene J. Weidman *In its* NASTRAN: Users' Experiences Sep. 1973 p 1-6 refs (For availability see N74-14586 05-32)
CSCL 20K

The objectives of the NASTRAN computer program system are discussed. Specific reference is made to the use of NASTRAN in the space shuttle program. The use of NASTRAN by agencies other than NASA is reported. The subjects presented are: (1) planned developments, (2) capability improvements, (3) efficiency improvements, and (4) new error correction procedure.
Author

N74-14588* MacNeal-Schwendler Corp., Los Angeles, Calif.
REVIEW OF NASTRAN DEVELOPMENT RELATIVE TO EFFICIENCY OF EXECUTION
Caleb W. McCormick *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 7-28 (For availability see N74-14586 05-32)
CSCL 20K

This paper reviews the development of NASTRAN relative to the efficiency of execution, with particular emphasis on those items which have changed significantly since the original release of NASTRAN. Features discussed include main and secondary storage utilization, matrix packing, matrix assembly, matrix multiplication, matrix decomposition and equation solution. Also a brief look into the future discusses the questions of faster arithmetic units and more effective storage utilization. In some cases the improvements in NASTRAN efficiency have resulted from taking advantage of hardware developments, while in other cases increased efficiency has resulted from improvements in the state of the art for data processing or matrix operations. The modular design of NASTRAN has made it possible to improve the efficiency in many parts of NASTRAN without changing the basic design of the program. Author

N74-14589* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASTRAN BUCKLING STUDY OF A LINEAR INDUCTION MOTOR REACTION RAIL
Jerry G. Williams *In its* NASTRAN: Users' Experiences Sep. 1973 p 29-48 refs (For availability see N74-14586 05-32)
CSCL 20K

NASTRAN was used to study problems associated with the installation of a linear induction motor reaction rail test track. Specific problems studied include determination of the critical axial compressive buckling stress and establishment of the lateral stiffness of the reaction rail under combined loads. NASTRAN results were compared with experimentally obtained values and satisfactory agreement was obtained. The reaction rail was found to buckle at an axial compressive stress of 11,400 pounds per square inch. The results of this investigation were used to select procedures for installation of the reaction rail. Author

N74-14590* Kleber-Colombes (France).
FINITE ELEMENT STRESS ANALYSIS OF POLYMERS AT HIGH STRAINS
Michel Durand and Etienne Jankovich *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 49-68 refs (For availability see N74-14586 05-32)
CSCL 20K

A numerical analysis is presented for the problem of a flat rectangular rubber membrane with a circular rigid inclusion undergoing high strains due to the action of an axial load. The neo-hookean constitutive equations are introduced into the general purpose TITUS program by means of equivalent hookean constants and initial strains. The convergence is achieved after a few iterations. The method is not limited to any specific program. The results are in good agreement with those of a company sponsored photoelastic stress analysis. The theoretical and experimental deformed shapes also agree very closely with one another. For high strains it is demonstrated that using the conventional HOOKE law the stress concentration factor obtained is unreliable in the case of rubberlike material. Author

N74-14591* Rockwell International Corp., Los Angeles Calif.
NASTRAN STATIC AND BUCKLING ANALYSIS - COMPARISON WITH OTHER LARGE-CAPACITY PROGRAMS
Lalit C. Shah *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 69-88 refs (For availability see N74-14586 05-32)
CSCL 20K

A square plate with clamped edges under a concentrated load was modeled using NASTRAN and ASKA finite element computer programs. Deflections were computed for various width-to-thickness ratios (b/t) of the plate element, and were compared against the classical theory to determine the b/t limitations. A cylinder with simply supported ends was modeled using NASTRAN and STAGS computer programs for buckling analysis. The models were subjected to a uniform radial pressure loading. Several parameters were changed, and the effects of those variations are presented. Utilizing these data, a model which will produce results comparable to published empirical data can be constructed and processed for a minimized cost. Author

N74-14592* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASTRAN ANALYSIS OF AN AIR STORAGE PIPING SYSTEM
Clarence P. Young, Jr., A. Harper Gerringer, and Richard W. Faison *In its* NASTRAN: Users' Experiences Sep. 1973 p 89-102 refs (For availability see N74-14586 05-32)
CSCL 20K

The application of NASTRAN to a complex piping design evaluation problem is summarized. Emphasis is placed on structural modeling aspects, problems encountered in modeling and analyzing curved pipe sections, principal results, and relative merits of using NASTRAN as a pipe analysis and design tool. In addition, the piping and manifolding system was analyzed with SNAP (Structural Network Analysis Program). The parallel SNAP study provides a basis for limited comparisons between NASTRAN and SNAP as to solution agreement and computer execution time and costs. Author

N74-14593* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL DISTORTION ANALYSIS OF A DEPLOYABLE PARABOLIC REFLECTOR
Lloyd R. Bruck and George H. Honeycutt *In its* NASTRAN: Users' Experiences Sep. 1973 p 103-121 (For availability see N74-14586 05-32)
CSCL 20K

A thermal distortion analysis of the ATS-6 Satellite parabolic reflector was performed using NASTRAN level 15.1. The same NASTRAN finite element method was used to conduct a one g static load analysis and a dynamic analysis of the reflector. In addition, a parametric study was made to determine which parameters had the greatest effect on the thermal distortions. The method used to model the construction of the reflector is described and the results of the analyses are presented. Author

N74-14594* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURAL ANALYSIS OF LIGHT AIRCRAFT USING NASTRAN
Michael T. Wilkinson (Louisiana Tech. Univ.) and Arthur C. Bruce (Louisiana Tech. Univ.) *In its* NASTRAN: Users' Experiences Sep. 1973 p 123-124 (For availability see N74-14586 05-32)
CSCL 20K

An application of NASTRAN to the structural analysis of light aircraft was conducted to determine the cost effectiveness. A model of the Baby Ace D model homebuilt aircraft was used. The NASTRAN model of the aircraft consists of 193 grid points connected by 352 structural members. All members are either rod or beam elements, including bending of unsymmetrical cross sections and torsion of noncircular cross sections. The aerodynamic loads applied to the aircraft were in accordance with FAA regulations governing the utility category aircraft. Author

N74-14595* Naval Ordnance Lab., White Oak, Md.
TRANSIENT ANALYSIS USING CONICAL SHELL ELEMENTS
Jackson C. S. Yang, Jack E. Goeller, and William T. Messick *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 125-142 refs (For availability see N74-14586 05-32)
CSCL 20K

The use of the NASTRAN conical shell element in static, eigenvalue, and direct transient analyses is demonstrated. The results of a NASTRAN static solution of an externally pressurized ring-stiffened cylinder agree well with a theoretical discontinuity analysis. Good agreement is also obtained between the NASTRAN direct transient response of a uniform cylinder to a dynamic end load and one-dimensional solutions obtained using a method of characteristics stress wave code and a standing wave solution. Finally, a NASTRAN eigenvalue analysis is performed on a hydroballistic model idealized with conical shell elements. Author

N74-14596* Boeing Aerospace Co., Seattle, Wash.
DYNAMIC ANALYSIS OF A LONG SPAN, CABLE-STAYED FREEWAY BRIDGE USING NASTRAN
W. L. Salus, R. E. Jones, and M. W. Ice (Boeing Computer Serv., Inc.) *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 143-168 refs (For availability see N74-14586 05-32)
CSCL 13B

The dynamic analysis for earthquake- and wind-induced response of a long span, cable-stayed freeway bridge by NASTRAN in conjunction with post-processors is described. Details of the structural modeling, the input data generation, and numerical results are given. The influence of the dynamic analysis on the bridge design is traced from the project initiation to the development of a successful earthquake and wind resistant configuration. Author

N74-14597* Grumman Aerospace Corp., Bethpage, N.Y.
NASTRAN ANALYSIS OF THE 1/8-SCALE SPACE SHUTTLE DYNAMIC MODEL
Murray Bernstein, Philip W. Mason, Joseph Zalesak, David J. Gregory, and Alvin Levy *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 169-241 refs (For availability see N74-14586 05-32)
CSCL 22B

The space shuttle configuration has more complex structural dynamic characteristics than previous launch vehicles primarily because of the high model density at low frequencies and the high degree of coupling between the lateral and longitudinal motions. An accurate analytical representation of these characteristics is a primary means for treating structural dynamics problems during the design phase of the shuttle program. The 1/8-scale model program was developed to explore the adequacy of available analytical modeling technology and to provide the means for investigating problems which are more readily treated experimentally. The basic objectives of the 1/8-scale model program are: (1) to provide early verification of analytical modeling procedures on a shuttle-like structure, (2) to demonstrate important vehicle dynamic characteristics of a typical shuttle design, (3) to disclose any previously unanticipated structural dynamic characteristics, and (4) to provide for development and demonstration of cost effective prototype testing procedures. Author

N74-14598* Computer Sciences Corp., El Segundo, Calif.
SEISMIC ANALYSIS OF NUCLEAR POWER PLANT STRUCTURES
James Chi-Dian Go *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 243-249 (For availability see N74-14586 05-32)
CSCL 13B

Primary structures for nuclear power plants are designed to resist expected earthquakes of the site. Two intensities are referred to as Operating Basis Earthquake and Design Basis Earthquake. These structures are required to accommodate these seismic loadings withtout loss of their functional integrity. Thus, no plastic yield is allowed. The application of NASTRAN in analyzing some of these seismic induced structural dynamic problems is described. NASTRAN, with some modifications, can be used to analyze most structures that are subjected to seismic loads. A brief review of the formulation of seismic-induced structural dynamics is also presented. Two typical structural problems were selected to illustrate the application of the various methods of seismic structural analysis by the NASTRAN system. Author

N74-14599* Avco Lycoming Div., Stratford, Conn.
BLADE DYNAMICS ANALYSIS USING NASTRAN
Peter S. Kuo *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 251-267 refs (For availability see N74-14586 05-32)
CSCL 20K

The complexities of turbine engine blade vibration are compounded by blade geometry, temperature gradients, and rotational speeds. Experience indicates that dynamics analysis using the finite element approach provides an effective means for predicting vibration characteristics of compressor and turbine blades whose geometry may be irregular, have curved boundaries, and be subjected to high temperatures and speeds. The NASTRAN program was chosen to help analyze the dynamics of normal modes, rotational stiffening and thermal effects on the normal modes, and forced responses. The program has produced reasonable success. This paper presents the analytical procedures and the NASTRAN results, in comparison with a conventional beam element program and laboratory data. Author

N74-14600* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NASTRAN DMAP ALTER FOR DETERMINING A LOCAL STIFFNESS MODIFICATION TO OBTAIN A SPECIFIED EIGENVALUE
William R. Case, Jr. *In its* NASTRAN: Users' Experiences Sep. 1973 p 269-283 (For availability see N74-14586 05-32)
CSCL 20K

A technique is described which has been programmed as a DMAP Alter to Rigid Format 3, for determining a stiffness matrix modification to obtain a specified eigenvalue for a structure. The stiffness matrix modifications allowable are those that can be described as the product of a single scalar variable and a matrix of constant coefficients input by the user. The program solves for the scalar variable multiplier which will yield a specified eigenvalue for the complete structure (provided it exists), makes the modification to the stiffness matrix, and proceeds in Rigid Format 3 to obtain the eigenvalues and eigenvectors of the modified structure. Author

N74-14601* Grumman Aerospace Corp., Bethpage, N.Y.
NASTRAN MULTIPARTITIONING AND ONE-SHOT SUBSTRUCTURING
Alvin Levy *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 285-300 refs (For availability see N74-14586 05-32)
CSCL 20K

For intermediate size problems where all the data is accessible, the present method of substructuring in three separate phases (for static analysis) is unneccessarily cumbersome. The versatility of NASTRAN's DMAP and internal logic lends itself to finding a practical alternative to these procedures whereby self-contained special-purpose ALTER packages can be written to be run in one pass. Two examples are presented here under the titles of multipartitioning and one-shot substructuring. The flow of multipartitioning resembles that of the present three-phase substructuring. The basic effect is to partition the structure into substructures and operate on each substructure separately. This can be used to reduce the bandwidth of a given problem as well as to store information which will allow a change to be made in one of the substructures in a later run. This latter procedure is carried out in a second program titled one-shot substructuring. Author

N74-14602* Westinghouse Research Labs., Pittsburgh, Pa. Research and Development Center.
NORMAL MODE ANALYSIS OF A ROTATING GROUP OF LASHED TURBINE BLADES BY SUBSTRUCTURES
A. W. Filstrup *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 301-321 refs (For availability see N74-14586 05-32)
CSCL 20K

A group of 5 lashed identical stream turbine blades is studied through the use of single level substructuring using NASTRAN level 15.1. An altered version, similar to DMAP Program Number 3 of the NASTRAN Newsletter, of Rigid Format 13.0 was used. Steady-state displacements and stresses due to centrifugal loads are obtained both without and with consideration of differential stiffness. The normal mode calculations were performed for blades at rest and at operating speed. Substructuring lowered the computation costs of the analysis by a factor of four. Author

N74-14603* Software Sciences, Inc., Hampton, Va.
SUBSTRUCTURE ANALYSIS TECHNIQUES AND AUTOMATION
Carl W. Hennrich and Edwin J. Konrath, Jr. *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 323-393 refs (For availability see N74-14586 05-32)
CSCL 20K

A basic automated substructure analysis capability for NASTRAN is presented which eliminates most of the logistical data handling and generation chores that are currently associated

with the method. Rigid formats are proposed which will accomplish this using three new modules, all of which can be added to level 16 with a relatively small effort. Author

N74-14604* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASTRAN CYCLIC SYMMETRY CAPABILITY
R. H. MacNeal, R. L. Harder, and J. B. Mason *In its* NASTRAN: Users' Experiences Sep. 1973 p 395-421 refs Prepared in cooperation with MacNeal-Schwendler Corp., Los Angeles, Calif. (For availability see N74-14586 05-32)
CSCL 20K

A development for NASTRAN which facilitates the analysis of structures made up of identical segments symmetrically arranged with respect to an axis is described. The key operation in the method is the transformation of the degrees of freedom for the structure into uncoupled symmetrical components, thereby greatly reducing the number of equations which are solved simultaneously. A further reduction occurs if each segment has a plane of reflective symmetry. The only required assumption is that the problem be linear. The capability, as developed, will be available in level 16 of NASTRAN for static stress analysis, steady state heat transfer analysis, and vibration analysis. The paper includes a discussion of the theory, a brief description of the data supplied by the user, and the results obtained for two example problems. The first problem concerns the acoustic modes of a long prismatic cavity imbedded in the propellant grain of a solid rocket motor. The second problem involves the deformations of a large space antenna. The latter example is the first application of the NASTRAN Cyclic Symmetry capability to a really large problem. Author

N74-14605* Universal Analytics, Inc., Los Angeles, Calif.
THREE ISOPARAMETRIC SOLID ELEMENTS FOR NASTRAN
Stephen E. Johnson and Eric I. Field *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 423-437 refs (For availability see N74-14586 05-32)
CSCL 20K

Linear, quadratic, and cubic isoparametric hexahedral solid elements have been added to the element library of NASTRAN. These elements are available for static, dynamic, buckling, and heat-transfer analyses. Because the isoparametric element matrices are generated by direct numerical integration over the volume of the element, variations in material properties, temperatures, and stresses within the elements are represented in the computations. In order to compare the accuracy of the new elements, three similar models of a slender cantilever were developed, one for each element. All elements performed well. As expected, however, the linear element model yielded excellent results only when shear behavior predominated. In contrast, the results obtained from the quadratic and cubic element models were excellent in both shear and bending. Author

N74-14606* Westinghouse Research Labs., Pittsburgh, Pa. Research and Development Center.
PLACING THREE-DIMENSIONAL ISOPARAMETRIC ELEMENTS INTO NASTRAN
M. B. Newman and A. W. Filstrup *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 439-454 refs (For availability see N74-14586 05-32)
CSCL 20K

Linear (8 node), parabolic (20 node), cubic (32 node) and mixed (some edges linear, some parabolic and some cubic) have been inserted into NASTRAN, level 15.1. First the dummy element feature was used to check out the stiffness matrix generation routines for the linear element in NASTRAN. Then, the necessary modules of NASTRAN were modified to include the new family of elements. The matrix assembly was changed so that the stiffness matrix of each isoparametric element is only generated once as the time to generate these higher order elements tends to be much longer than the other elements in NASTRAN. This paper presents some of the experiences and difficulties of inserting a new element or family of elements into NASTRAN. Author

N74-14607* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NEW PLATE AND SHELL ELEMENTS FOR NASTRAN
R. Narayanaswami *In its* NASTRAN: Users' Experiences Sep. 1973 p 455-484 refs (For availability see N74-14586 05-32)
CSCL 20K

A new higher order triangular plate-bending finite element is presented which possesses high accuracy for practical mesh subdivisions and which uses only translations and rotations as grid point degrees of freedom. The element has 18 degrees of freedom, the transverse displacement and two rotations at the vertices and mid-side grid points of the triangle. The transverse displacement within the element is approximated by a quintic polynomial; the bending strains thus vary cubically within the element. Transverse shear flexibility is taken into account in the stiffness formulation. Two examples of static and dynamic analysis are included to show the behavior of the element. Author

N74-14608* Israel Aircraft Industries Ltd., Lod.
FAST MODAL EXTRACTION IN NASTRAN VIA THE FEER COMPUTER PROGRAM
Malcolm Newman and Aaron Pipano *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 485-506 refs (For availability see N74-14586 05-32)
CSCL 20K

A new eigensolution routine, FEER (Fast Eigensolution Extraction Routine), used in conjunction with NASTRAN at Israel Aircraft Industries is described. The FEER program is based on an automatic matrix reduction scheme whereby the lower modes of structures with many degrees of freedom can be accurately extracted from a tridiagonal eigenvalue problem whose size is of the same order of magnitude as the number of required modes. The process is effected without arbitrary lumping of masses at selected node points or selection of nodes to be retained in the analysis set. The results of computational efficiency studies are presented, showing major arithmetic operation counts and actual computer run times of FEER as compared to other methods of eigenvalue extraction, including those available in the NASTRAN READ module. It is concluded that the tridiagonal reduction method used in FEER would serve as a valuable addition to NASTRAN for highly increased efficiency in obtaining structural vibration modes. Author

N74-14609* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC FLUTTER ANALYSIS ADDITION TO NASTRAN
Robert V. Doggett, Jr. and Robert L. Harder *In its* NASTRAN: Users' Experiences Sep. 1973 p 507-529 refs Prepared in cooperation with MacNeal-Schwendler Corp., Los Angeles, Calif. (For availability see N74-14586 05-32)
CSCL 20K

A subsonic flutter analysis capability has been developed for NASTRAN, and a developmental version of the program has been installed on the CDC 6000 series digital computers at the Langley Research Center. The flutter analysis is of the modal type, uses doublet lattice unsteady aerodynamic forces, and solves the flutter equations by using the k-method. Surface and one-dimensional spline functions are used to transform from the aerodynamic degrees of freedom to the structural degrees of freedom. Some preliminary applications of the method to a beamlike wing, a platelike wing, and a platelike wing with a folded tip are compared with existing experimental and analytical results. Author

N74-14610* Lockheed-Georgia Co., Marietta.
CRACKED FINITE ELEMENTS PROPOSED FOR NASTRAN
J. A. Aberson and J. M. Anderson (Ga. Inst. of Tech.) *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 531-550 refs (For availability see N74-14586 05-32)
CSCL 20K

The recent introduction of special crack-tip singularity elements, usually referred to as cracked elements, has brought the power and flexibility of the finite-element method to bear much more effectively on fracture mechanics problems. This paper recalls the development of two cracked elements and presents the results of some applications proving their accuracy and economy. Judging from the available literature on numerical methods in fracture mechanics, it seems clear that the elements described have been used more extensively than any others in practical fracture mechanics applications. Author

N74-14611* McDonnell-Douglas Astronautics Co., St. Louis, Mo.
THE CONSTRAINT METHOD: A NEW FINITE ELEMENT TECHNIQUE
Chung-Ta Tsai and Barna A. Szabo (Washington Univ., St. Louis) *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 551-568 refs (For availability see N74-14586 05-32)
CSCL 20K

An approch to the finite element method which utilizes families of conforming finite elements based on complete polynomials is presented. Finite element approximations based on this method converge with respect to progressively reduced element sizes as well as with respect to progressively increasing orders of approximation. Numerical results of static and dynamic applications of plates are presented to demonstrate the efficiency of the method. Comparisons are made with plate elements in NASTRAN and the high-precision plate element developed by Cowper and his co-workers. Some considerations are given to implementation of the constraint method into general purpose computer programs such as NASTRAN. Author

N74-14612* Computer Software Management and Information Center, Athens, Ga.
NASTRAN DISTRIBUTION THROUGH COSMIC c08
Margaret K. Park *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 569-571 refs (For availability see N74-14586 05-32)
CSCL 09B

The NASTRAN program package is one of the most important in terms of size and use in the COSMIC inventory at the University of Georgia. A brief history of the COSMIC facility as it relates to the NASTRAN program package is presented, followed by a discussion of the NASTRAN disseminations. COSMIC, which is the acronym for the Computer Software Management and Information Center, is operated by the University of Georgia's Computer Center under contract to NASA. The purpose of COSMIC is to make available to the public the computer software and documentation developed as part of the NASA program. It is, perhaps, best described as a clearinghouse for the NASA-sponsored computer software, although the functions specified under the contract go much further than simply duplicating the programs and documentation for distribution. A sizeable portion of the workscope involves screening the programs to insure that they are free of syntax errors, that all necessary subroutines are present, and that the documentation includes sufficiently detailed instructions to allow purchasers to install and operate the program or system. Author

N74-14613* Sperry Univac, St. Paul, Minn. Application/Research Dept.
THE APPLICATION OF NASTRAN AT SPERRY UNIVAC HOLLAND
G. Koopmans *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 573-583 ref (For availability see N74-14586 05-32)
CSCL 20K

Very divergent problems arising with different calculations indicate that NASTRAN is not always accessible for common use. Problems with engineering, modelling, and use of the program system are analysed and a way of solution is outlined. Related to this, some supplementary modifications are made at Sperry Univac Holland to facilitate the program for the less skilled user. The implementation of a new element also gives an insight into the use of NASTRAN at Sperry Univac Holland. As the users of Univac computers are from very different kinds of industries like shipbuilders, petrochemical industries, and building industries, the variety of problems coming from these users is very large. This variety results in experience not with one special kind of calculation nor one special kind of construction, but with a wide area of problems arising in the use of NASTRAN. These problems can roughly be divided into three different groups: (1) recognition of what is to be calculated and how, (2) construction of a model, and (3) handling the NASTRAN program. These are the basic problems for every less skilled user of NASTRAN and the Application/Research Department of Sperry Univac has to give reasonable answers to these questions. Author

N74-14614* Pioneer Service and Engineering Co., Chicago, Ill.
SOME STUDIES ON THE USE OF NASTRAN FOR NUCLEAR POWER PLANT STRUCTURAL ANALYSIS AND DESIGN c22
Achyut V. Setlur and Muniratham Valathur *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 585-594 refs (For availability see N74-14586 05-32)
CSCL 18I

Studies made on the use of NASTRAN for nuclear power plant analysis and design are presented. These studies indicate that NASTRAN could be effectively used for static, dynamic and special purpose problems encountered in the design of such plants. Normal mode capability of NASTRAN is extended through a post-processor program to handle seismic analysis. Static and dynamic substructuring is discussed. Extension of NASTRAN to include the needs in the civil engineering industry is discussed. Author

N74-14615* Avco Corp., Nashville, Tenn. Aerostructures Div.
NASTRAN USERS' EXPERIENCE OF AVCO AEROSTRUCTURES DIVISION
Charles L. Blackburn and Carl A. Wilhelm *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 595-609 refs (For availability see N74-14586 05-32)
CSCL 20K

The NASTRAN experiences of a major structural design and fabrication subcontractor that has less engineering personnel and computer facilities than those available to large prime contractors are discussed. Efforts to obtain sufficient computer capacity and the development and implementation of auxiliary programs to reduce manpower requirements are described. Applications of the NASTRAN program for training users, checking out auxiliary programs, performing in-house research and development, and structurally analyzing an Avco designed and manufactured missile case are presented. Author

N74-14616* Bell Helicopter Co., Fort Worth, Tex.
STATIC AND DYNAMIC HELICOPTER AIRFRAME ANALYSIS WITH NASTRAN
H. E. Wilson and J. D. Cronkhite *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 611-619 refs (For availability see N74-14586 05-32)
CSCL 20K

The use of NASTRAN at Bell Helicopter Company for structural static and dynamic analysis of a helicopter airframe is described. Analysis of airframe internal loads, main rotor isolation systems, and airframe vibration is discussed. The use of each rigid format for these types of analysis is summarized. Suggested improvements to NASTRAN to increase its effectiveness in performing helicopter airframe analysis are given. Author

N74-14617* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE ANALYSIS OF AN AUTOMOBILE SHIPPING CONTAINER
Lo-Ching Hua (Anal. Eng. Serv., Inc.), Sang H. Lee (Pullman-Standard), and Bradford Johnstone (Pullman-Standard) *In its* NASTRAN: Users' Experiences Sep. 1973 p 621-625 (For availability see N74-14586 05-32)
CSCL 13D

The design and development of automobile shipping containers to reduce enroute damage are discussed. Vibration tests were conducted to determine the system structural integrity. A dynamic analysis was made using NASTRAN and the results of the test and the analysis are compared. Author

N74-14618* Computer Sciences Corp., El Segundo, Calif.
IMPLEMENTATION EXPERIENCES OF NASTRAN ON CDC CYBER 74 SCOPE 3.4 OPERATING SYSTEM c08
James Chi-Dian Go and Ronald G. Hill (Westinghouse Hanford Co.) *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 627-631 (For availability see N74-14586 05-32)
CSCL 09B

The implementation of the NASTRAN system on the CDC CYBER 74 SCOPE 3.4 Operating System is described. The flexibility of the NASTRAN system made it possible to accomplish the change with no major problems. Various sizes of benchmark

and test problems, ranging from two hours to less than one minute CP time were run on the CDC CYBER SCOPE 3.3, Univac EXEC-8, and CDC CYBER SCOPE 3.4. The NASTRAN installation deck is provided. Author

N74-14619* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD FOR TRANSFERRING NASTRAN DATA BETWEEN DISSIMILAR COMPUTERS c08
James L. Rogers, Jr. *In its* NASTRAN: Users' Experiences Sep. 1973 p 633-639 ref (For availability see N74-14586 05-32)
CSCL 09B

The NASTRAN computer program is capable of executing on three different types of computers: (1) the CDC 6000 series, (2) the IBM 360-370 series, and (3) the Univac 1100 series. A typical activity requiring transfer of data between dissimilar computers is the analysis of a large structure such as the space shuttle by substructuring. Models of portions of the vehicle which have been analyzed by subcontractors using their computers must be integrated into a model of the complete structure by the prime contractor on his computer. Presently the transfer of NASTRAN matrices or tables between two different types of computers is accomplished by punched cards or a magnetic tape containing card images. These methods of data transfer do not satisfy the requirements for intercomputer data transfer associated with a substructuring activity. To provide a more satisfactory transfer of data, two new programs, RDUSER and WRTUSER, were created. Author

N74-14620* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INTERACTIVE NASTRAN PREPROCESSOR c08
Willianna W. Smith *In its* NASTRAN: Users' Experiences Sep. 1973 p 641-659 refs (For availability see N74-14586 05-32)
CSCL 09B

A Langley Research Center version of NASTRAN Level 15.1.0 designed to provide the analyst with an added tool for debugging massive NASTRAN input data is described. The program checks all NASTRAN input data cards and displays on a CRT the graphic representation of the undeformed structure. In addition, the program permits the display and alteration of input data and allows reexecution without physically resubmitting the job. Core requirements on the CDC 6000 computer are approximately 77,000 octal words of central memory. Author

N74-14621* United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft.
NASTRAN DATA GENERATION OF HELICOPTER FUSELAGES USING INTERACTIVE GRAPHICS c08
J. B. Sainsbury-Carter and John H. Conaway *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 661-678 refs (For availability see N74-14586 05-32)
CSCL 09B

The development and implementation of a preprocessor system for the finite element analysis of helicopter fuselages is described. The system utilizes interactive graphics for the generation, display, and editing of NASTRAN data for fuselage models. It is operated from an IBM 2250 cathode ray tube (CRT) console driven by an IBM 370/145 computer. Real time interaction plus automatic data generation reduces the nominal 6 to 10 week time for manual generation and checking of data to a few days. The interactive graphics system consists of a series of satellite programs operated from a central NASTRAN Systems Monitor. Fuselage structural models including the outer shell and internal structure may be rapidly generated. All numbering systems are automatically assigned. Hard copy plots of the model labeled with GRID or elements ID's are also available. General purpose programs for displaying and editing NASTRAN data are included in the system. Utilization of the NASTRAN interactive graphics system has made possible the multiple finite element analysis of complex helicopter fuselage structures within design schedules. Author

N74-14622* McDonnell-Douglas Astronautics Co., St. Louis, Mo.
AN INTERACTIVE GRAPHICS SYSTEM TO FACILITATE FINITE ELEMENT STRUCTURAL ANALYSIS
Robert C. Burk and Fred H. Held *In* NASA. Langley Res. Center NASTRAN: Users' Experiences Sep. 1973 p 679-695 refs (For availability see N74-14586 05-32)
CSCL 20K

The characteristics of an interactive graphics systems to facilitate the finite element method of structural analysis are described. The finite element model analysis consists of three phases: (1) preprocessing (model generation), (2) problem solution, and (3) postprocessing (interpretation of results). The advantages of interactive graphics to finite element structural analysis are defined. Author

N74-14623* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SIMPLIFIED MODAL PLOTTING TECHNIQUE FOR THE REPRESENTATION OF COMPLEX STRUCTURAL MODELS c08
Stuart L. Hanlein *In its* NASTRAN: Users' Experiences Sep. 1973 p 697-705 (For availability see N74-14586 05-32)
CSCL 09B

A plotting method has been developed that has proven to be useful in rapidly defining the mode shapes of a complex spacecraft. The reduction of the complex model to a simple stick plot is accomplished by augmenting the existing NASTRAN plot package with constrained plot elements. Both the existing NASTRAN modal plot package and the stick plots of a representative mode are presented for comparison. The NASTRAN plot package provides the capability of generating modal deformations (mode shapes) resulting from real eigenvalue analysis. These modal deformations of the structural model may be displayed in the deformed shape either alone or superimposed on the undeformed shape. Another available method of displaying the modal deformations is by means of displacement vectors at the grid points Author

N74-14624* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASTRAN POSTPROCESSOR PROGRAM FOR TRANSIENT RESPONSE TO INPUT ACCELERATIONS c08
Robert T. Wingate, Thomas C. Jones, and Maria V. Stephens *In its* NASTRAN: Users' Experiences Sep. 1973 p 707-734 refs (For availability see N74-14586 05-32)
CSCL 09B

The description of a transient analysis program for computing structural responses to input base accelerations is presented. A hybrid modal formulation is used and a procedure is demonstrated for generating and writing all modal input data on user tapes via NASTRAN. Use of several new Level 15 modules is illustrated along with a problem associated with reading the postprocessor program input from a user tape. An example application of the program is presented for the analysis of a spacecraft subjected to accelerations initiated by thrust transients. Experience with the program has indicated it to be very efficient and economical because of its simplicity and small central memory storage requirements. Author

N74-14625*# Boeing Commercial Airplane Co., Seattle, Wash.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF AIRCRAFT METAL STRUCTURES REINFORCED WITH FILAMENTARY COMPOSITES. PHASE 3: MAJOR COMPONENT DEVELOPMENT Final Report
L. L. Bryson and J. E. McCarty Washington NASA Nov. 1973 112 p refs
(Contract NAS1-8858)
(NASA-CR-2122; D6-60136-3) Avail: NTIS HC $4.25 CSCL 20K

Analytical and experimental investigations, performed to establish the feasibility of reinforcing metal aircraft structures with advanced filamentary composites, are reported. Aluminum-boron-epoxy and titanium-boron-epoxy were used in the design and manufacture of three major structural components. The components were representative of subsonic aircraft fuselage and window belt panels and supersonic aircraft compression panels. Both unidirectional and multidirectional reinforcement concepts were employed. Blade penetration, axial compression, and inplane shear tests were conducted. Composite reinforced structural components designed to realistic airframe structural criteria demonstrated the potential for significant weight savings

while maintaining strength, stability, and damage containment properties of all metal components designed to meet the same criteria. Author

N74-14626*# Scientific Translation Service, Santa Barbara, Calif.
STABILITY AND OSCILLATION OF ELASTIC SYSTEMS: MODERN CONCEPTS, PARADOXES AND ERRORS
Ya. G. Panovko and I. I. Gubanova Washington NASA Nov. 1973 426 p Transl. into ENGLISH of the book "Ustoychivost' i Kolebaniya Uprugikh Sistem. Sovremennyye Kontseptsii, Paradoksy i Oshibki" Moscow, Nauka Press, 1967 420 p
(Contract NASw-2035)
(NASA-TT-F-751) Avail: NTIS HC $8.75 CSCL 20K

Contemporary problems such as jumps in elastic systems, problems of aeroelasticity, problems of frictional self-oscillations, and self-synchronization are discussed. The stability of equilibrium shapes of elastic systems is examined. Problems of oscillations of linear systems are discussed, including systems with a fractional number of degrees of freedom as well as free oscillations of a cantilever in the field of centrifugal forces. For individual titles, see N74-14627 through N74-14628.

N74-14627* Scientific Translation Service, Santa Barbara, Calif.
PART 1: THE STABILITY OF EQUILIBRIUM SHAPES OF ELASTIC SYSTEMS
Ya. G. Panovko and I. I. Gubanova *In its* Stability and Oscillation of Elastic Systems: Mod. Concepts, Paradoxes and Errors (NASA-TT-F-751) Nov. 1973 p 1-183 refs Transl. into ENGLISH of the book "Ustoychivost' i Kolebaniya Uprugikh Sistem. Sovremennyye Kontseptsii, Paradoksy i Oshibki" Moscow, Nauka Press, 1967 420 p (For availability see N74-14626 05-32)
CSCL 20K

The stability of equilibrium shapes of elastic systems is examined. Stability loss in the case of similar equilibrium shapes, the disappearance of stable equilibrium shapes, and the disappearance of any forms of equilibrium are discussed. The error made by Euler in analyzing stability loss is pointed out, and Mises' truss is used as an example of stability loss in the case of similar equilibrium shapes. Author

N74-14628* Scientific Translation Service, Santa Barbara, Calif.
PART 2: OSCILLATIONS OF ELASTIC SYSTEMS
In its Stability and Oscillation of Elastic Systems: Mod. Concepts, Paradoxes and Errors NASA-TT-F-751) Nov. 1973 p 184-418 refs Transl. into ENGLISH of the book "Ustoychivost' i Kolebaniya Uprugikh Sistem. Sovremennyye Kontseptsii, Paradoksy i Oshibk i" Moscow, Nauka Press, 1967 420 p (For availability see N74-14626 05-32)
CSCL 20K

Problems of oscillations of linear systems are discussed, including systems with a fractional number of degrees of freedom as well as free oscillations of a cantilever in the field of centrifugal forces. Four methods of solving the problem of the action of periodic instantaneous impulses are presented. The Tacoma catastrophe is analyzed and used as an example of aeroelastic oscillations. Problems of nonlinear system oscillations include the vibration maintenance of rotation, the Sommerfeld effect, and self-oscillations of a quasi-system with dry friction. Author

N74-14629*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF BOUNDARY INTEGRAL METHOD TO ELASTOPLASTIC ANALYSIS OF V-NOTCHED BEAMS
Walter Rzasnicki and Alexander Mendelson 1974 28 p refs Proposed for presentation at 7th US Natl. Congr. of Appl. Mech., Boulder, Colo., 3-7 Jun. 1974; sponsored by NAS-NRC
(NASA-TM-X-71472; E-7658) Avail: NTIS HC $3.50 CSCL 20K

The boundary integral equation method was applied in the solution of the plane elastoplastic problems. The use of this method was illustrated by obtaining stress and strain distributions for a number of specimens with a single edge notch and subjected to pure bending. The boundary integral equation method reduced the non-homogeneous biharmonic equation to two coupled Fredholm-type integral equations. These integral equations were replaced by a system of simultaneous algebraic equations and solved numerically in conjunction with the method of successive elastic solutions. Author

N74-14630*# Old Dominion Univ. Research Foundation, Norfolk, Va. School of Engineering.
FINITE ELEMENT ANALYSIS OF A COMPOSITE MATERIAL INTERFACE Final Technical Report
Kenneth H. Murray Aug. 1973 43 p ref
(Contract NAS1-9434)
(NASA-CR-132341; TR-73-C1) Avail: NTIS HC $4.25 CSCL 20K

A finite element model of a composite material interface is developed to study the influence of the interface on the thermal strain in the composite. A plane stress model is used with an axisymmetric model as a check. The interface thickness, thermal coefficient, modulus, Poisson's ratio and the percent of mineral in the composite are variables in the study. The results confirmed the usability of the finite element model in studying the polymer-mineral interface. Author

N74-14631*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC SINGLE-MODE FLUTTER AND BUFFET OF A LOW ASPECT RATIO WING HAVING A SUBSONIC AIRFOIL SHAPE
Larry L. Erickson Washington Jan. 1974 24 p refs
(NASA-TN-D-7346; A-4966) Avail: NTIS HC $2.75 CSCL 01A

Transonic flutter and buffet results obtained from wind-tunnel tests of a low aspect ratio semispan wing model are presented. The tests were conducted to investigate potential transonic aeroelastic problems of vehicles having subsonic airfoil sections. The model employed NACA 00XX-64 airfoil sections in the streamwise direction and had a 14 deg leading edge sweep angle. Aspect ratio, and average thickness were 4.0, 0.35, and 8 percent, respectively. The model was tested at Mach numbers from 0.6 to 0.95 at angles of attack from 0 deg to 15 deg. Two zero lift flutter conditions were found that involved essentially single normal mode vibrations. With boundary layer trips on the model, flutter occurred in a narrow Mach number range centered at about Mach 0.90. The frequency and motion of this flutter were like that of the first normal mode vibration. With the trips removed flutter occurred at a slightly high Mach number but in a mode strongly resembling that of the second normal mode. Author

N74-14632# Bhabha Atomic Research Centre, Bombay (India).
DEFORMATION MECHANISMS IN ZIRCALOY-2 AT LOW TEMPERATURE
K. G. Samuel and P. Rodriguez 1973 23 p refs
(BARC-660) Avail: AEC Depository Libraries HC $3.25

The effect of temperature and strain rate on the yield and flow behavior of Zircaloy-2 was investigated between 77 and 660 K. In addition to uninterrupted tensile tests, strain-rate change tests involving ten-fold changes from the above base strain rate were also carried out. The activation parameters associated with thermally activated dislocation motion were evaluated. The study revealed that the temperature and strain-rate dependence of flow stress in Zircaloy-2 between 77 and 660 K arises from the interstitial solutes. Substitutional alloying additions like Sn contribute only to the athermal component of flow stress. The activation energy (for dislocation motion) vs temperature data yielded two linear regions as were obtained in earlier studies on zirconium-oxygen alloys, interpreted as due to two consecutive deformation mechanisms in the two regions of temperature. It is suggested that the anomalous variation of thermal activation parameters with temperature above 300 K arises, more likely, from dynamic strain aging effects and/or from variations in internal stress with temperature. It is also possible that a single mechanism is not rate controlling above 300 K. Author (NSA)

N74-14633# Auburn Univ., Ala. Dept. of Mechanical Engineering.
STRESS DISTRIBUTION OF A CYLINDRICAL SHELL NONRADIALLY PENETRATED INTO A SPHERICAL PRESSURE VESSEL

J. C. M. Yu, C. H. Chen, and W. A. Shaw [1973] 39 p refs Presented at 2d Intern. Congr. for Pressure Vessel and Piping Technol., San Antonio, 1 Oct. 1973 Sponsored by AEC
(Conf-731003-3) Avail: NTIS HC $4.00

The results of the stress distribution of a cylindrical shell nonradially penetrated into a spherical shell under internal pressure are given. The compound-shell is separated along the junction curve into two cylindrical shells and a spherical shell. For small angles of inclination the junction curve can be approximated as a plane curve. Consideration of larger angles of inclination where the approximation is not valid is included. The continuity conditions along the junction curve are satisfied by the method of least square boundary point matching. Numerical results of the stresses at the outer and inner fibers of the compound-shell at different locations were obtained and plotted into curves. Comparison of the stresses of the compound-shells with and without intrusions was made and it was found that they differ only in quantity and no pronounced deviation in nature is observed. Author (NSA)

N74-14634# Oak Ridge National Lab., Tenn.
EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF THE STRUCTURAL BEHAVIOR OF NOZZLE-TO-SHELL ATTACHMENTS
J. P. Callahan and W. L. Greenstreet Aug. 1973 78 p refs
(Contract W-7405-eng-26)
(ORNL-TM-4163) Avail: NTIS HC $6.00

The objectives of the program are (1) the development and verification of methods of analysis for various types of reinforced and unreinforced openings in pressure vessels, (2) the performance of experimental and analytical studies of these openings and (3) the preparation of the resulting information in forms suitable for code-rule development. The studies encompass elastic and plastic behavior of individual openings and elastic behavior of closely spaced multiple openings. Participants in the studies include 11 independent organizations at 7 separate institutions. The investigations are described and program participants identified. The organization of the program, the work undertaken by each participating organization, and the work remaining to be done are covered. Author (NSA)

N74-14635# Sandia Labs., Livermore, Calif.
DYNAMIC BUCKLING OF THIN ALUMINUM, CIRCULAR CYLINDRICAL SHELLS SUBJECTED TO A UNIFORM IMPULSE LOADING
D. L. Wesenberg Aug. 1973 53 p refs
(Contract AT(29-1)-789)
(SLL-73-45) Avail: NTIS HC $4.75

The dynamic buckling of a series of thin 6061-T4 aluminum, circular cylindrical shells was investigated. UNIVALVE, a Sandia dynamic elastic-plastic ring code, was modified to predict both early time dynamic buckling response and later time permanent buckle deformation. The magnetic induction technique was then used to subject shells with radius-to-thickness ratios of 100, 200, and 300 to uniformly distributed impulse loading. Good correlation was obtained between the numerical predictions and the experimental measurements of applied impulse, permanent buckle deformation, and buckle wave numbers. Author (NSA)

N74-14636# Brown Univ., Providence, R.I. Div. of Engineering.
DETERMINATION OF ELASTODYNAMIC CRACK TIP STRESS FIELDS
L. B. Freund and J. R. Rice May 1973 15 p refs
(Contract AT(11-1)-3084)
(COO-3084-23) Avail: NTIS HC $3.00

A linear elastic body in plane strain which contains a stationary crack and which is initially at rest and stress free is considered. It is shown that if the elastodynamic displacement field and stress intensity factor are known, as functions of crack length, for a symmetrical distribution of time-varying forces which acts on the body, subsequent to t = 0, then the stress intensity factor due to any other symmetrical load system whatsoever which acts on the same body may be directly determined. The results are obtained by extension of Rice's mode of derivation of the corresponding Bueckner-Rice elastostatic results to Laplace-transformed elastodynamic variables. Likewise, the existence of a universal elastodynamic weight function for any given cracked body is demonstrated. As an application, Freund's recent result for the stress intensity factor due to suddenly applied concentrated forces on the crack surfaces is derived directly by our method, from de Hoop's earlier solution for suddenly applied uniform pressures. Author (NSA)

N74-14637# California Univ., Livermore. Lawrence Livermore Lab.
STATIC STRESS ANALYSIS OF AXISYMMETRIC SOLIDS WITH MATERIAL AND GEOMETRIC NON-LINEARITIES BY THE FINITE ELEMENT METHOD
M. Hartzman 19 Jan. 1973 33 p refs
(Contract W-7405-eng-48)
(UCRL-51390) Avail: NTIS HC $4.00

A technique for analyzing axisymmetric solids subjected to axisymmetric static loads is described. The material properties are described by elastic-plastic incremental stress-strain relations of the Prandtl-Reuss type. The complete formulation includes geometric effects due to assumed large displacements and rotations. The technique therefore incorporates both material and geometric nonlinearities. A solution is obtained by applying the finite element method and using an incremental-iterative numerical algorithm. The technique was applied to the problem of an internally pressurized thick cylinder where considerable deformation occurred. Comparison with an alternate numerical solution indicates reasonable agreement. Author (NSA)

N74-14638# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIFFRACTION OF ELASTIC WAVES IN MULTIPLY CONNECTED BODIES
A. N. Guz and V. T. Golovchan 5 Sep. 1973 281 p refs Transl. into ENGLISH of the publ. "Difraktsiya Uprugikh Voln v Mnogosvyaznykh Telakh" USSR, 1972 p 1-256
(AD-767893; FTD-MT-24-418-73) Avail: NTIS CSCL 20/11

Contents: Linear problems of wave dynamics of isotropic deformable bodies; Representation of the solution of a wave equation in certain coordinate systems; Diffraction of waves in bodies limited by circular cylindrical surfaces; Wave diffraction in bodies with spherical cavities; Solution to problems of the diffraction of elastic waves on cylindrical surfaces; Wave diffraction in semi-bounded bodies with cavities; Principles of the theory of wave propagation in fibrous and granular media. GRA

N74-14639# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
MULTI-DIMENSIONAL WAVE PROPAGATION IN SOLIDS DUE TO IMPACT LOADING BY THE METHOD OF CHARACTERISTICS. CASE 1: COMPUTATIONAL METHOD FOR TWO-DIMENSIONAL WAVES IN A LINEAR ELASTIC SOLID Interim Report
Moche Ziv Apr. 1973 67 p refs
(Grant AF-AFOSR-2330-72; AF Proj. 9782)
(AD-767796; TAE-178; AFOSR-73-1722TR; SR-1) Avail: NTIS CSCL 20/11

A computational method is presented for the solution of multi-dimensional hyperbolic partial differential equations governing the dynamic deformation of solids. The method is based on characteristics formulation of the hyperbolic differential equations. Thus generated waves are located in the medium and the differential equations holding along these waves are obtained. The algorithm consists of a new method which evaluates the unknown variables along the leading wave and then couples the first generator to the motion behind it. The unknowns along the leading wave are resolved by means of kinematic and dynamic conditions existing across this wave. The entire multi-dimensional solution domain is then linked to the leading wave by the method of characteristics. The mathematical avenues used to develop this computational method are potentially capable of solving multi-dimensional wave problems in various types of solids. As a first step in the report, the described technique is confined to field equations defining the deformation of a linear elastic solid in two-space and time independent variables. Author (GRA)

N74-14640# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
DYNAMIC PLASTIC BUCKLING OF COMPLETE SPHERICAL SHELLS

Norman Jones and Chung S. Ahn Aug. 1973 62 p refs
(Contract N00014-67-A-0204-0032; Grant NSF GK-38562)
(AD-768035; Rept-73-19) Avail: NTIS CSCL 20/11

A theoretical investigation is undertaken into the dynamic instability of complete spherical shells which are loaded impulsively. The linear elastic, elastic-plastic and rigid-plastic material idealizations are used in the various theoretical procedures. The threshold velocities for the elastic and rigid-plastic models are larger than those for cylindrical shells having the same R/h ratios and material parameters, while the critical mode numbers are similar. Author (GRA)

N74-14641# Watervliet Arsenal, N.Y.
ADJOINT VARIATIONAL PRINCIPLES FOR COUPLED THERMOMECHANICAL SYSTEMS AND APPLICATION TO DYNAMIC STABILITY PROBLEMS
Julian J. WU Aug. 1973 21 p refs
(AD-767260; R-WV-T-2-27-73) Avail: NTIS CSCL 20/11

In conjunction with the differential equations of coupled thermoelasticity with initial stresses, adjoint variational principles were formulated in the report by introducing a set of adjoint differential equations. The natural and imposed boundary conditions for the original and the adjoint problems are obtained also with respect to each variational principle. These results can be used as basis for the finite element or other Ritz type of approximations to solve dynamic stability problems with nonconservative loads. Author (GRA)

N74-14642# Naval Postgraduate School, Monterey, Calif.
DESIGN BUCKLING CURVES FOR GUN LAUNCHED ROCKETS
David Salinas and Robert E. Ball 24 Aug. 1973 18 p refs
(AD-767688; NPS-59ZC73081A) Avail: NTIS CSCL 19/7

An investigation of elastic buckling of gun-launched motor cases is considered. The SATANS finite difference computer program was used for the analysis. Comparative results from other buckling models were obtained to verify the results. The results are summarized in a set of design curves and show that for the proposed design parameters, the elastic behavior is exceeded before buckling can occur. Author (GRA)

N74-14643# Syracuse Univ. Research Inst., N.Y. Dept. of Mechanical and Aerospace Engineering.
ON THE STIFFNESS, STRESSES AND BUCKLING ANALYSIS OF CORRUGATED SHEAR WEBS
Charles Libove Mar. 1973 45 p refs
(Grant NSF GK-35814)
(PB-222837/7; MAE-5170-T1) Avail: NTIS HC $3.00 CSCL 01C

This paper first reviews some recently published theoretical analysis of the shear stiffness and associated flexural stresses of corrugated shear webs having descrete attachments between the ends of the corrugations and the framing members. Some additional numerical results related to this problem are presented, the additional results bearing on the stiffness of trapezoidally corrugated shear webs having crest and trough elements of different width. Buckling analysis of continuously attached corrugated shear webs and a development of total-potential-energy expressions believed to be suitable for this analysis are also presented. GRA

N74-14644# Watervliet Arsenal, N.Y.
EXTENSIONAL VIBRATIONS OF SIMPLY SUPPORTED LAMINATED RECTANGULAR PLATES
Charles R. Thomas Aug. 1973 42 p refs
(DA Proj. 1F0-61102-A-35D)
(AD-768090; R-WV-T-X-28-73) Avail: NTIS CSCL 20/11

The extensional vibrations of simply supported rectangular plates are considered from the viewpoint of the recently derived effective stiffness: velocity corrected Sun plate theory by passing solutions harmonic in both plate width and length through the differential equations of motion and boundary conditions such that the boundary conditions for simple supports are automatically satisfied. The results are compared to extensional frequencies for a reduced effective modulus: velocity corrected Sun Plate theory. It is concluded that for extensional vibrations a higher order approximation in going to the plate theory is necessary to bring out the effects of microstructure which are present in the continuum theory. Author (GRA)

N74-14645# Watervliet Arsenal, N.Y.
EFFECTIVE STIFFNESS FLEXURAL VIBRATIONS OF SIMPLY SUPPORTED RECTANGULAR PLATES WITH VELOCITY CORRECTION
Charles R. Thomas Jul. 1973 65 p refs
(DA Proj. 1F0-61102-A-35D)
(AD-768089; R-WV-T-X-24-73) Avail: NTIS CSCL 20/11

The previously developed velocity corrected effective stiffness of microstructure plate theory is used to study the flexural vibrations of simply supported rectangular plates and comparisons are made to an effective modulus plate theory. In each case frequency equations for simply supported edges are developed by passing solutions harmonic in both length and width through the differential equations while automatically satisfying the conditions for simple supports. Careful consideration is given to the variations of dimensionless frequency with such dimensionless parameters as width-to-thickness ratio, number of layer pairs, density ratio, thickness ratio, width-to-length ratio, and elastic ratio and such results are discussed graphically. Author (GRA)

N74-14646# Connecticut Univ., Storrs. Dept. of Civil Engineering.
ANALYSIS OF THERMALLY LOADED LAMINATED CIRCULAR PLATES Final Report
John F. Carney, III Jan. 1973 77 p refs Sponsored by Connecticut DOT
(PB-221957/4; JHR-72-58) Avail: NTIS HC $6.00 CSCL 13C

The investigation is concerned with the formulation of a method to determine stress levels in laminated plate systems, when subjected to thermal and/or mechanical loadings, for use in simulation of a highway pavement system. The physical parameters which affect the stress are listed. Parametric investigations are carried out to determine the influence of the individual parameters on the temperature-induced stress levels in one-, two-, and three-layered pavement systems. In addition, the formulation is modified to include in the study the simultaneous application of mechanical (wheel and subbase) and thermal loadings. Results are obtained for the thermally loaded three-layered system with and without mecahnical loadings to determine when and how much vehicular traffic increases the stress levels in the pavement present due to a temperature-gradient. GRA

N74-14539 Societe Nationale Industrielle Aerospatiale, Cannes (France).
ARE SINUSOIDAL VIBRATION TESTS REALISTIC? [LES ESSAIS AUX VIBRATIONS SINUSOIDALES SONT-ILS REALISTES?]
D. Auternaud *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 41-49 In FRENCH (For availability see N74-14536 05-31)

N74-14541 GEC Turbine Generators, Leicester (England).
RESPONSE OF STRUCTURES TO SINE PLUS RANDOM NOISE EXCITATION
L. Yeh and I. Vesty *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 71-84 refs (For availability see N74-14536 05-31)

N74-14551 Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrt Konstruktionen.
DATA ACQUISITION AND REDUCTION IN VIBRATION EXPERIMENTS
J. A. Agyris, W. Aicher, and K. Eberle *In* ESRO Struct. and Thermal Tests, Vol. 1 Jun. 1973 p 303-331 (For availability see N74-14536 05-31)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N74-14647 Iowa State Univ. of Science and Technology, Ames.
HIGH TEMPERATURE HEAT CONTENT OF SELECTED RARE EARTH METALS BY LEVITATION CALORIMETRY Ph.D. Thesis
Lawrence Albert Stretz 1973 155 p
(Contract W-7405-eng-82)
(IS-T-583) Avail: Univ. Microfilms Order No. 73-25256

A levitation calorimetry system was devised by coupling a levitation melting apparatus with a conventional calorimeter. The levitation melting apparatus was powered by a high-frequency generator and was capable of levitating molten metal samples ranging from 0.5 to 2 grams in an inert atmosphere. The calorimeter was a copper block drop calorimeter contained in isothermal surroundings. The system was used to measure the heat contents of yttrium, lanthanum, praseodymium, and neodymium at temperatures above their melting points. Previous work on these metals ended at 1950 K for yttrium and at 1373 K for lanthanum, praseodymium, and neodymium. By use of levitation calorimetry, the experimental measurements were extended up to 2360 K for yttrium, 2319 K for lanthanum, 2289 K for praseodymium, and 2246 K for neodymium.
Dissert. Abstr.

N74-14648# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
TURBULENT HEAT TRANSFER MEASUREMENTS IN A MACH 15 FLOW
B. E. Richards and C. Appels May 1973 36 p refs Presented at the EUROMECH 43 Colloq. on Heat Transfer in Turbulent Boundary Layers with Variable Fluid Properties, Goettingen, West Germany, 14-16 May 1973
(VKI-Preprint-73-2) Avail: NTIS HC $4.00

Turbulent boundary layer heat transfer data is being generated on various model geometries, both simple and complicated, in the Mach 15 high unit Reynolds flow of a free-piston tunnel. Thin film platinum resistance gages are used to measure heat transfer rates on surfaces at small angles to the flow; calorimeter sensors are used on surfaces at large angles. The van Driest prediction of heat transfer slightly underpredicts the turbulent heating on the Mach 12 boundary layer developing on a flat plate at 5 deg incidence to the flow; Sommer and Short reference enthalpy method predicts well the M = 1.5 flow on a smooth surfaced 50 deg half-angle cone. Such comparisons depend greatly on the precision of the data and on the assumptions and inputs supplied to the theories. Author

N74-14649# *Imperial Coll. of Science and Technology, London (England).
NEW WAYS OF PREDICTING HEAT-TRANSFER PERFORMANCE
D. B. Spalding Oct. 1973 33 p refs Presented at the Heat Transfer Society, 1973
(HTS/73/49) Avail: NTIS HC $3.75

A transcript is presented of a lecture concerning recent developments in predicting heat transfer performance. Topics discussed include: the designer's problem, calculation of local heat transfer conductances, calculations of convective interactions, and applications of numerical methods. Computer models are now available for two-dimensional and three-dimensional flows, and computer programs can now solve the differentail equations and produce the heat flux at the wall for whatever boundary conditions are applicable. K.M.M.

N74-14650*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF WATER INJECTION ON NITRIC OXIDE EMISSIONS OF A GAS TURBINE COMBUSTOR BURNING ASTM JET-A FUEL
Nicholas R. Marchionna, Larry A. Diehl, and Arthur M. Trout Washington Dec. 1973 24 p refs
(NASA-TM-X-2958; E-7531) Avail: NTIS HC $2.75 CSCL 20M

Tests were conducted to determine the effect of water injection on oxides of nitrogen (NOx) emissions of a full annular, ram induction gas turbine combustor burning ASTM Jet-A fuel. The combustor was operated at conditions simulating sea-level takeoff and cruise conditions. Water at ambient temperature was injected into the combustor primary zone at water-fuel ratios up to 2. At an inlet-air temperature of 589 K (600 F) water injection decreased the NOx emission index at a constant exponential rate: NOx = NOx (o) e to the -15 W/F power (where W/F is the water-fuel ratio and NOx(o) indicates the value with no injection). The effect of increasing combustor inlet-air temperature was to decrease the effect of the water injection. Other operating variables such as pressure and reference Mach number did not appear to significantly affect the percent reduction in NOx. Smoke emissions were found to decrease with increasing water injection. Author

N74-14651*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF WATER INJECTION ON NITRIC OXIDE EMISSIONS OF A GAS TURBINE COMBUSTOR BURNING NATURAL GAS FUEL
Nicholas R. Marchionna, Larry A. Diehl, and Arthur M. Trout Washington Dec. 1973 26 p refs
(NASA-TM-X-2959; E-7565) Avail: NTIS HC $3.00 CSCL 20M

The effect of direct water injection on the exhaust gas emissions of a turbojet combustor burning natural gas fuel was investigated. The results are compared with the results from similar tests using ASTM Jet-A fuel. Increasing water injection decreased the emissions of oxides of nitrogen (NOX) and increased the emissions of carbon monoxide and unburned hydrocarbons. The greatest percentage decrease in NOX with increasing water injection was at the lowest inlet-air temperature tested. The effect of increasing inlet-air temperature was to decrease the effect of the water injection. The reduction in NOX due to water injection was almost identical to the results obtained with Jet-A fuel. However, the emission indices of unburned hydrocarbons, carbon monoxide, and percentage nitric oxide in NOX were not. Author

N74-14652# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THE THERMODYNAMIC PROPERTIES OF COMPRESSED GASEOUS AND LIQUID FLUORINE
Rolf Prydz and G. C. Straty Sep. 1973 197 p refs
(NBS-TN-392-Rev) Avail: SOD HC $1.50 as C13.46:392 (Revised)

An apparatus was constructed and used successfully to measure vapor pressure and PVT data of fluorine from the triple point to 300 K at pressures to about 24 MN sq m. Material problems caused by the toxic and corrosive nature of fluorine were solved. A network of isotherm and isochore polynomials and a truncated virial equation were used to represent all PVT data. These equations represent the data with an average standard deviation of about 0.02 percent in density, the corresponding accuracy being estimated at 0.1 percent. Equations for the saturated liquid and vapor densities, the vapor pressure curve, the melting line, and the ideal gas properties are also presented. Comparisons are given to published values of the second virial coefficients, vapor pressures, and saturation densities. Additional comparisons are also made to measured specific heats and latent heats of vaporization. Values are reported for the triple point and critical point parameters together with the temperature and saturation densities at the normal boiling point. Author

N74-14653*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF INCREASED FUEL TEMPERATURE ON EMISSIONS OF OXIDES OF NITROGEN FROM A GAS TURBINE COMBUSTOR BURNING NATURAL GAS
Nicholas R. Marchionna Washington Dec. 1973 20 p refs
(NASA-TM-X-2930; E-7618) Avail: NTIS HC $2.75 CSCL 20M

An annular gas turbine combustor was tested with heated natural gas fuel to determine the effect of increasing fuel temperature on the formation of oxides of nitrogen. Fuel temperatures ranged from ambient to 800 K (980 F). Combustor pressure was 6 atmospheres and the inlet air temperature ranged from 589 to 894 K (600 to 1150 F). The NOx emission index increased with fuel temperature at a rate of 4 to 9 percent per 100 K (180 F), depending on the inlet air temperature. The rate of increase in NOx was lowest at the highest inlet air temperature tested. Author

N74-14654*# Grumman Aerospace Corp., Bethpage, N.Y.
HEAT PIPE RADIATOR Final Report, Jun. 1972 - Sep. 1973
B. Swerdling and J. Alario Oct. 1973 125 p refs
(Contract NAS9-12848)
(NASA-CR-134172; HPR-14) Avail: NTIS HC $8.25 CSCL 20M

A 15,000 watt spacecraft waste heat rejection system utilizing heat pipe radiator panels was investigated. Of the several concepts initially identified, a series system was selected for more in-depth analysis. As a demonstration of system feasibility, a nominal 500 watt radiator panel was designed, built and tested. The panel, which is a module of the 15,000 watt system, consists of a variable conductance heat pipe (VCHP) header, and six isothermalizer heat pipes attached to a radiating fin. The thermal load to the VCHP is supplied by a Freon-21 liquid loop via an integral heat exchanger. Descriptions of the results of the system studies and details of the radiator design are included along with the test results for both the heat pipe components and the assembled radiator panel. These results support the feasibility of using heat pipes in a spacecraft waste heat rejection system. Author

N74-14655*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WASP: A FLEXIBLE FORTRAN 4 COMPUTER CODE FOR CALCULATING WATER AND STEAM PROPERTIES
Robert C. Hendricks, Ildiko C. Peller, and Anne K. 'Baron Washington Nov. 1973 119 p refs
(NASA-TN-D-7391; E-7339) Avail: NTIS HC $4.25 CSCL 20M

A FORTRAN 4 subprogram, WASP, was developed to calculate the thermodynamic and transport properties of water and steam. The temperature range is from the triple point to 1750 K, and the pressure range is from 0.1 to 100 MN/m2 (1 to 1000 bars) for the thermodynamic properties and to 50 MN/m2 (500 bars) for thermal conductivity and to 80 MN/m2 (800 bars) for viscosity. WASP accepts any two of pressure, temperature, and density as input conditions. In addition, pressure and either entropy or enthalpy are also allowable input variables. This flexibility is especially useful in cycle analysis. The properties available in any combination as output include temperature, density, pressure, entropy, enthalpy, specific heats, sonic velocity, viscosity, thermal conductivity, surface tension, and the Laplace constant. The subroutine structure is modular so that the user can choose only those subroutines necessary to his calculations. Metastable calculations can also be made by using WASP. Author

N74-14656*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ZERO-GRAVITY VENTING OF THREE REFRIGERANTS
Thomas L. Labus, John C. Aydelott, and Geraldine E. Amling Washington Jan. 1974 41 p refs
(NASA-TN-D-7480; E-7509) Avail: NTIS HC $3.00 CSCL 20M

An experimental investigation of venting cylindrical containers partially filled with initially saturated liquids under zero-gravity conditions was conducted in the NASA Lewis Research Center 5-second zero-gravity facility. The effect of interfacial mass transfer on the ullage pressure response during venting was analytically determined, based on a conduction analysis applied to an infinitely planer (flat) liquid-vapor interface. This pressure response was compared with both the experimental results and an adiabatic decompression computation. Author

N74-14657# Ernst-Mach-Inst., Freiburg (West Germany).
GASDYNAMIC THEORY OF SPINNING DETONATION
F. Schultz-Grunow Jun. 1973 12 p refs
(Rept-4/73) Avail: NTIS HC $3.00

Extremely high pressures are observed in the detonation head, and chemical processes occuring in detonations are also reviewed. It becomes evident that the spinning detonation propagates behind a self induced, axially propagating shock. This process suggests the method of successive approximations. Its first step yields the pitch, the pressure ratios, and the axial component of propagation velocity with sufficient accuracy. Author (ESRO)

N74-14658# Hanford Engineering Development Lab., Richland, Wash.
ANALYTICAL EXPRESSIONS FOR ENTHALPY AND HEAT CAPACITY FOR URANIUM-PLUTONIUM OXIDE
R. L. Gibby, L. Leibowitz, J. F. Kerrisk, and D. G. Clifton Jun. 1973 26 p refs
(Contract AT(45-1)-210)
(HEDL-TME-73-60) Avail: NTIS HC $4.00

Enthalpy data reported for UO2-(20 to 25) wt% PuO2 in the range from room temperature to melting were fitted to a theoretically based equation. The equation can be used to calculate enthalpy, and differentiated to obtain heat capacity in this range. The parameters of the equation are compared with corresponding theoretical values calculated for the UO2-PuO2 lattice. The smoothed values of enthalpy and heat capacity given by the theoretically based equations were also fitted with polynomial functions of temperature providing simpler expressions for these two properties. Author (NSA)

N74-14659# California Univ., Livermore. Lawrence Livermore Lab.
THERMODYNAMIC PROPERTIES OF XENON IN THE FLUID REGIME BETWEEN 1 AND 10 eV
H. C. Graboske, Jr., M. VanThiel, and R. J. Olness 10 May 1973 30 p refs
(Contract W-7405-eng-48)
(UCID-16260) Avail: NTIS HC $3.50

The thermodynamic properties of fluid xenon in the temperature range of 1 to 10 eV were calculated by using a variety of theoretical models. A complete thermodynamic description is best given by the combination of an equilibrium statistical mechanical model at lower temperatures with a statistical atom model at higher temperatures. Equation-of-state data and shock Hugoniots were determined. Author (NSA)

N74-14660# Sandia Corp., Livermore, Calif.
TURBULENT INTERFERENCE HEATING ON SEVERAL SMALL FIN CONFIGURATIONS
H. W. Coleman and E. C. Lemmon Aug. 1973 13 p refs
(Contract AT(29-1)-789)
(SLL-73-5256) Avail: NTIS HC $3.00

When aerodynamic control fins are used on high velocity vehicles, regions of increased heating occur on the vehicle surface in the vicinity of the fin and also on the body of the fin itself. The flow field in such regions is complex and does not yield itself to a straightforward analytical description. It is therefore necessary to investigate this type of problem experimentally. Turbulent heating distributions are measured in the interference region on and around several small, highly swept fin configurations mounted on a cone. Author (NSA)

N74-14661# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
EXPERIMENTAL AND THEORETICAL ANALYSIS OF THE HEAT TRANSFER IN A CYLINDRICAL SHELL HEATED ALONG TWO OPPOSITE GENERATORS
Joseph Frum and Menahem Baruch Mar. 1973 49 p refs
(Contract F44620-71-C-0116; Grant AF-AFOSR-2394-72; AF Proj. 9782)
(AD-767252; TAE-177; SR-7) Avail: NTIS CSCL 01/3

An experimental program was conducted in order to determine the temperature profile in a cylindrical shell heated along two opposite generators. Many experimental tests were performed. Aluminum cylindrical shells were tested on a test rig designed for this case. The heating was performed by two line heaters and the temperature distribution as function of time and space

was measured by a set of thermocouples located on the surface of the shell. A closed form solution for the respective heat transfer problem is given. The agreement between theory and experiments is very good. Author (GRA)

N74-14662# Hercules, Inc., Magna, Utah. Bacchus Works.
VELOCITY COUPLING COMBUSTION INSTABILITY Final Report, Aug. 1971 - Jul. 1973
Merrill W. Beckstead, M. Duane Horton, Maurice Krashin, and A. Garn Butcher Sep. 1973 209 p refs Prepared in cooperation with Brigham Young Univ., Provo, Utah
(Contract F04611-72-C-0003)
(AD-767723; AFRPL-TR-73-73) Avail: NTIS CSCL 21/2

The objectives of the program were: To develop an understanding of the role of velocity-coupled combustion response in solid propellant combustion instability, to evaluate various methods for quantitatively measuring this response, and to select the most appropriate method for future development and evaluation. The study was divided into three phases: Supporting analyses to provide direction for the experimental phases; a phenomenological study to determine relative effects of propellant combustion in an oscillatory environment; and the evaluation of test techniques to find a quantitative tool for characterizing velocity coupling. (Modified author abstract) GRA

N74-14663# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BASE PRESSURE BEHIND FLAT BODIES DURING DIFFUSION NEAR-WAKE COMBUSTION
K. E. Yurchenok 6 Sep. 1973 15 p refs Transl. into ENGLISH from Tr. Inst. Aviats. Priborostr. (Leningrad), no. 66, 1970 p 49-56
(AD-767995; FTD-HT-23-843-73) Avail: NTIS CSCL 21/2

A method and results are given for computing base pressure behind flat bodies during diffusion near-wake combustion. The method makes it possible to consider the effect of combustion on the rate profile in the mixing zone, and thus to more exactly determine the necessary parameters on the dividing (zero) flow line for computing the base pressure. The base pressure is considered according to the Korst method. As an example base pressure is considered during the combustion of hydrogen and carbon monoxide in air. GRA

N74-14664*# Naval Ordnance Lab., White Oak, Md.
HNS/TEFLON, A NEW HEAT RESISTANT EXPLOSIVE
Harry Heller and Albert L. Bertram 1 Jul. 1973 37 p refs Sponsored by NASA
(NASA-CR-136530; AD-767932; NOLTR-73-163) Avail: NTIS HC $4.00 CSCL 19/1

HNS/Teflon (90/10) is a new pressed explosive developed for use in the Apollo program. The major advantages of HNS/Teflon are (1) excellent thermal stability at elevated temperatures, (2) superior resistance to sublimation at high temperatures and low pressures and (3) ease of molding powder preparation, pressing and machining. The impact sensitivity of HNS/Teflon is between that of Comp B and Comp A-3 while its explosive performance is about the same as TNT. Under the severe environmental conditions of the moon's surface, this explosive successfully performed its intended function of generating seismic waves in the Apollo ALSEP and LSPE experiments. (Modified author abstract) GRA

N74-14305 Pisa Univ. (Italy). Ist. di Macchine.
PHOTOMETRIC MEASUREMENTS OF EXHAUST SMOKE TRAILS BY JET ENGINES
M. Lucchesini and D. Dini *In* AGARD Atmospheric Pollution by Aircraft Engines Sep. 1973 12 p refs (For availability see N74-14271 05-20)

34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N74-14665 Oklahoma Univ., Norman.
MANERGY: AN ENERGY MANAGEMENT MODEL OF THE UNITED STATES FOR THE PREDICTION OF ENERGY DEMAND, RESOURCE CONSUMPTION, ENVIRONMENTAL EFFECTS, THE ASSESSMENT OF NEW TECHNOLOGY, AND ENERGY RESOURCE ALTERNATIVES Ph.D. Thesis
William Woodrow Talley, II 1973 723 p
Avail: Univ. Microfilms Order No. 73-23921

A computerized, systems-analysis model of the United States energy system has been developed and presented in code form. The model was designed for use as a management tool for assessing the consequences of resources and fuel alternatives, environmental controls, and technological advances. The assessment guidelines are presented as resource consumptions, environmental impacts, and balance of payment deficits to the year 2100. The model's capabilities and its inherent flexibility have been demonstrated for a baseline case and several alternatives. The base case was based on current energy use patterns, diversified resource development, projected fuel splits, population and gross national product projections, and reasonable advances in technology. The model has sufficient flexibility to include the results of the many existing and future studies on energy supply and demand. It quantifies the impacts of energy policy decisions into acceptable indices. As such, it has the capability to provide energy management guidelines necessary to make decisions on research and development priorities, legislation and regulations. Dissert. Abstr.

N74-14666 Institute of Gas Technology, Chicago, Ill.
REVIEW OF WORLD ENERGY SUPPLIES
Henry R. Linden London Intern. Gas Union 1973 40 p refs Presented at the 12th World Gas Conf., Nice, 1973
(IGU/A-1-73) Copyright. Avail: Issuing Activity

On the basis of currently definable technology and economics, world energy resources are insufficient to support historical rates of growth much beyond the middle of the 21st century. Further, conventional energy supply systems appear to be inadequate to support these growth rates under the expected limitations of the use of investment capital, raw materials, and air, water and land resources. New energy supply systems are discussed, including those for conversion of the lower grades of fossil fuels to nonpolluting fluid fuels and those employing hydrogen as the energy form. The state of technological development of the most promising fossil fuel conversion processes, and their thermal efficiencies, operating characteristics, investment costs, and prospects for industrial use are reviewed. Particular reference is made to the major commercialization effort already underway in the United States. The advantages of a hydrogen-based economy over complete electrification are discussed in detail. Although major emphasis is placed on the adequacy of fossil fuel and uranium resources in meeting future requirements and on delivery systems for these energy sources which are compatible with investment cost and environmental limitations, the major renewable energy resources are also reviewed briefly. Author

N74-14667# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
DFVLR ANNUAL REVIEW, 1972 [DFVLR JAHRESBERICHT 1972]
1972 477 p refs In GERMAN
Avail: NTIS HC $26.00

The various research activities are reported that were performed by the German Aeronautical and Aerospace Institute during 1972. Topics stretch from aerodynamical engineering aspects to the management of space flight missions. For individual titles, see N74-14668 through N74-14677.

N74-14668 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 1: FLUID MECHANICS [FACHGEBIET 1: STROEMUNGSMECHANIK] c12
In its DFVLR Annual Review, 1972 1972 p 3-93 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Applied and theoretical research activities are reported on the following subjects: airplane aerodynamics, missile aerodynamics, aerospace dynamics, cascade flow aerodynamics, and special problems in fluid mechanics. Transl. by G.G.

N74-14669 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 2: FLIGHT MECHANICS, FLIGHT CONTROL [FACHGEBIET 2: FLUGMECHANIK, FLUGFUEHRUNG] **c01**
In its DFVLR Annual Review, 1972 1972 p 95-149 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Aviation oriented problems studied pertain to operational procedures to increase aircraft handling qualities and flight safety. Development of redundant control systems for satellite, missile, and aircraft guidance is discussed. Special flight systems consider rescue and recovery methods for military applications. Transl. by G.G.

N74-14670 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 3: STABILITY, CONSTRUCTION MATERIALS, CONSTRUCTION METHODS [FACHGEBIET 3: FESTIGKEIT, WERKSTOFFE, BAUWEISEN] **c18**
In its DFVLR Annual Review, 1972 1972 p 151-197 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Research in relation to aerospace industrial application stresses problems of structure, materials, and design. Strength and stability of structures subjected to temperature and other stress fields are considered in the framework of aeroelastic and aeromechanical problems of aircraft and spacecraft. Weight optimal utilization of fiber reinforced composite materials is emphasized. Transl. by G.G.

N74-14671 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 4: PROPULSION AND ENERGY [FACHGEBIET 4: ANTRIEBE UND ENERGETIK] **c28**
In its DFVLR Annual Review, 1972 1972 p 199-281 refs (For availability see N74-14667 05-34)

Problems of turbojet engines include engine noise and propulsion systems. Investigations on cascades in the trisonic regime, on problems of compressor stages, and on combustion with emission of pollutants are considered. Work on energy transfer and electrical propulsion for space vehicles, technological applications of plasma flows, as well as chemical and physical studies on rocket propulsion systems and their lubricants, is also included. Transl. by G.G.

N74-14672 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 5: ELECTRICITY [FACHGEBIET 5: ELEKTRONIK] **c10**
In its DFVLR Annual Review, 1972 1972 p 283-315 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Research activities cover radiation of microwaves, interaction phenomena between waves and propagation media, and analytical studies of practical radio and satellite ground station telecommunication systems. Spaceborne electronics for data processing and signal analysis are developed. Transl. by G.G.

N74-14673 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SECTION 6: AEROSPACE PHYSICS, SPACE SIMULATION, AEROSPACE MEDICINE [FACHGEBIET 6: FLUGRAUMPHYSIK RAUMSIMULATION, FLUGMEDIZIN] **c31**
In its DFVLR Annual Review, 1972 1972 p 317-350 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Effects of environmental conditions on aircraft, flying bodies, and rockets are investigated by various simulation techniques in connection with the operation of aeronautical and space vehicles by man. Transl. by G.G.

N74-14674 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
COMPUTER CENTERS FOR PROCESSING SCIENTIFIC AEROSPACE DATA [RECHENZENTREN] **c08**
In its DFVLR Annual Review, 1972 1972 p 351-381 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Service activities at the computing centers provide mathematical support for aerospace research institutes. Theoretical computations, test data processing, training in computer programming, and development of multiple processing systems are covered. Transl. by G.G.

N74-14675 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
AEROTECHNOLOGY IN AVIATION PROBLEMS [LUFTFAHRTTECHNISCHER BEREICH] **c02**
In its DFVLR Annual Review, 1972 1972 p 383-401 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Scientific-engineering coordination with Federal ministries and industries is provided in planning, accomplishing, and evaluating aviation problems of safety and traffic regulations. This includes supplying of pilots and aircraft for scientific tasks of research and testing. Transl. by G.G.

N74-14676 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
RESEARCH IN CHEMICAL ROCKET PROPULSION, SATELLITE ELECTRONICS, AND SPACECRAFT COMMUNICATIONS [BEREICH FUER RAUMFLUGPROJEKTE] **c31**
In its DFVLR Annual Review, 1972 1972 p 403-436 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

Organization and management support is provided for space programs, customer realization of space- and extraterrestrial-flight projects, as well as for launch and operation of spacecraft missions. Testing facilities and ground operation installations are used to evaluate the various space flight projects. Transl. by G.G.

N74-14677 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
RESEARCH IN EXTRATERRESTRIAL PHYSICS AND ASTROPHYSICS [ARBEITSGEMEINSCHAFT FUER WELTRAUMFORSCHUNG (014)]
In its DFVLR Annual Review, 1972 1972 p 437-439 refs In GERMAN; ENGLISH summary (For availability see N74-14667 05-34)

The committee for aerospace research is competent for the cooperation in the field of extraterrestrial research performing scientific experiments by means of sounding rockets, satellites or probes, and space flight research assisting in the preparing and performing of experiments. The study group disposes of an office, the tasks of which are the coordination of common activities and the cooperation in the preplanning phase of space flight research missions. Author

N74-14678# Committee on Space Research (COSPAR), Paris (France).
COSPAR INFORAMTION BULLETIN NO. 68, DECEMBER 1973
Dec. 1973 53 p refs
Avail: NTIS HC $4.75

Past conferences are reported, and scheduled meeting are listed. The memorandum of understanding concerning European-U.S. cooperation, and the data systems test are discussed along with the air mass transformation experiment. The resolution of the second assembly of the Scientific Committee on Problems of the Environment are listed. A list of satellites, and space probes from 27 June to 27 September 1973 is included. F.O.S.

N74-14679# New South Wales Univ., Sydney (Australia).
APPROACH TO PHYSICAL SCIENCES, 1973
G. E. Chapman, ed. 1973 320 p refs
Avail: NTIS HC $18.00; Publications Officer, Univ. of New South Wales, P. O. Box 1, Kensington N.S.W., 2033: $3.00

The summer session course in science is presented. The themes were chemistry of the living environment, and biophysics. Topics discussed include: desalinization by dead and living matter, importance of tetrapyrrolic pigments in biolological systems, photochemical smog, physics of nerves, feedback control systems in animal and man, metal chelation in man, and nuclear medicine. F.O.S.

N74-14680# Committee on Aeronautical and Space Sciences (U. S. Senate).
STATE OF THE AEROPSACE INDUSTRY
Washington GPO 1973 222 p Hearings before Comm. on Aeron. and Space Sci., 93d Congr. 1st Sess., 26-27 Sep. 1973 Avail: Comm. on Aeron. and Space Sci.

The hearings are reported concerning the role of the aerospace industries in the aeronautics and space program. Topics discussed include: technology utilization, aviation financing, recommended investment levels for research and development, a balanced program for the future, and the national aeronautics and space objectives. F.O.S.

N74-14681# Committee on Science and Astronautics (U. S. House).
SKYLAB 3
Washington GPO 1973 20 p Hearing before Comm. on Sci. and Astronaut., 93d Congr., 1st Sess., No. 17, 6 Nov. 1973 Avail: Comm. on Sci. and Astronaut.

The report of the Skylab 3 crew to congress is presented. F.O.S.

N74-14682*# Techtran Corp., Glen Burnie, Md.
ECONOMICS OF AIR TRANSPORT
M. C. Alvarez Washington NASA Jan. 1974 20 p Transl. into ENGLISH from Rev. Aeron. Astron. (Spain), no. 388, Mar. 1973 p 173-183
(Contract NASw-2485)
(NASA-TT-F-15249) Avail: NTIS HC $3.00 CSCL 05C

The costs of air transportation are analyzed, giving attention to direct and indirect costs. Systems of cost analysis are considered together with the effect of individual parameters on the costs of operation. Attention is given to cruising speed, flight time, total operational time, aircraft design, and aircraft manufacture. A first estimation of operational costs has to take into account the weight of the aircraft, the weight of the fuel needed during the flight, the fuel reserve, and questions of the selection of one of three operational approaches in conducting the flight. Direct costs of the flight operation are discussed in detail together with expenses for maintenance, inspection, depreciation, and fuel costs. Indirect expenses include costs of administration, publicity, and airport charges. Author

N74-14683*# Library of Congress, Washington, D.C. Science and Technology Div.
ASTRONAUTICS AND AERONAUTICS, 1971: CHRONOLOGY ON SCIENCE, TECHNOLOGY, AND POLICY
NASA 1972 481 p refs Sponsored by NASA
(NASA-SP-4016; LC-65-60308) Avail: NTIS MF $1.45, SOD HC $3.80 CSCL 05A

A comprehensive chronological reference of world wide aerospace events is presented. Policy statements, comments on the impact of technology, social concern, and biographical notes are included. F.O.S.

N74-14684# RAND Corp., Santa Monica, Calif.
ENERGY POLICY RESEARCH AND THE STATE OF FLORIDA
William E. Mooz Aug. 1973 17 p Sponsored by NSF and the State of Calif.
(P-5078) Avail: NTIS HC $3.00

A discussion of state energy problems and the research required to support the selection of policies designed to solve them. The example chosen is the State of Florida, in which future energy demands may be in conflict with its unique environment, and the basis for the discussion is Rand's past and present energy work for the National Science Foundation and the State of California. Author

N74-14685# RAND Corp., Santa Monica, Calif.
RECORDS, COMPUTERS AND THE RIGHTS OF CITIZENS
Willis H. Ware Aug. 1973 12 p
(P-5077) Avail: NTIS HC $3.00

The harmful consequences that might result from automated personal data systems are discussed along with the safeguards for protecting individuals. The concentration of information within computer files at one location with multiple remote access terminals is considered to offer opportunities for misuse of the personal information. Suggestions considered for protecting data subjects against harm include the licensing and certification of programmers, and the ombudsman approach. Fair Information Practices Codes are suggested for safeguards of the data. It is further recommended that the use of the Social Security Number (SSN) be restricted, and that the individual have the legal right to refuse to disclose his SSN. F.O.S.

N74-14686# Interior Dept., Washington, D.C. Office of Energy Conservation.
FEDERAL AGENCY ENERGY CONSERVATION Quarterly Report, Jul. - Sep. 1973
Dec. 1973 13 p ref
(QR-1) Avail: NTIS HC $3.00

On June 29, 1973, the President ordered the Federal government to achieve a 7 percent reduction in its anticipated energy consumption over the succeeding 12 months. While there are more than 80 departments and agencies within the Federal government, nearly all of the energy is consumed by the 11 cabinet departments and five large agencies. The focus of the effort has been in these 16 units. In all, a total of 20.8 percent savings in energy was made when compared to anticipated use during FY 1974. Monetary savings amounted to about $160 million. The Department of Defense is the largest user of energy in the government (86 percent), and it effected the greatest savings, mostly in its diminished use of automotive and aviation fuels. Seven other agencies met or exceeded the goal. Author

N74-14687# Interior Dept., Washington, D.C. Office of Energy Conservation.
FEDERAL ENERGY CONSERVATION Interim Report
Oct. 1973 33 p
Avail: NTIS HC $3.75

This interim report estimates total energy use in the sixteen major Federal agencies during Fiscal Year 1973. It will provide a baseline against which to measure progress in succeeding years. The sixteen largest agencies consumed 2.26 quadrillion British thermal units of energy in Fiscal Year 1973, of which about 60 percent was for vehicle and equipment operations and about 40 percent for building and facility lighting, heating and cooling. Specific actions being taken to achieve the targeted reduction in energy use during the current fiscal year are described. As expected, all agencies will seek to reduce lighting, heating and cooling, as these are the easiest to put into motion, monitor, and adjust as experiences dictate. A host of other ideas have also surfaced, however, including reduced travel and shifts to more energy-conservative ways to travel, employee participation through use of public transport, bicycles, and the like. Author

N74-14688# National Bureau of Standards, Washington, D.C. Inst. for Applied Technology.
ENERGY CONSERVATION THROUGH EFFECTIVE UTILIZATION
Charles A. Berg Feb. 1973 55 p refs
(NBSIR-73-102) Avail: NTIS HC $4.75

In two major sectors of the economy (building services and industrial processes), accounting for approximately 75 percent of the total national energy consumption, energy utilization was found to be inefficient. It is estimated that in these two sectors, as much as 25 percent of the energy consumed annually by the nation as a whole may be lost through ineffective practices. Possible reasons for the existence of ineffective utilization are considered, and possible means of improving effectiveness of ultilization are discussed. The levels of effort to promote effective utilization of energy are identified as: (1) the effective use of present fuels in present processes, (2) utilization of presently unused energy sources, and (3) more effective investment of energy in durable and maintainable products. Author

N74-14689*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A GUIDE FOR PERFORMING SYSTEM SAFETY ANALYSIS
J. M. Brush, R. W. Douglass, III., F. R. Williamson, and Martin C. Dorman, ed. 18 Jan. 1974 45 p refs
(NASA-TM-X-64799) Avail: NTIS HC $4.25 CSCL 13L

A general guide is presented for performing system safety analyses of hardware, software, operations and human elements of an aerospace program. The guide describes a progression of

activities that can be effectively applied to identify hazards to personnel and equipment during all periods of system development. The general process of performing safety analyses is described; setting forth in a logical order the information and data requirements, the analytical steps, and the results. These analyses are the technical basis of a system safety program. Although the guidance established by this document cannot replace human experience and judgement, it does provide a methodical approach to the identification of hazards and evaluation of risks to the system. Author

N74-14690# Committee on Banking and Currency (U.S. House).
EPA POLLUTION REGULATIONS AND FUEL SHORTAGE: THE IMPACT ON MASS TRANSIT
Washington GPO 1973 689 p refs Hearings before Comm. on Banking and Currency, 93d Congr., 1st Sess., 26, 30, and 31 Jul. 1973
Avail: Subcomm. on Urban Mass Transportation

A hearing was held before the Subcommittee on Urban Mass Transportation of the Committee on Banking and Currency of the House of Representatives to discuss the Environmental Protection Agency pollution regulations and the fuel shortage. Specific emphasis was placed on the impact of the fuel shortage on mass transportation and recommendations for improving mass transportation as an energy saving measure. Testimony from representatives of various petroleum companies was presented to show the causes for the current fuel shortages and steps being taken to improve the situation. The effects of the proposals for reducing fuel shortages on the quality of the environment are emphasized. Author

N74-14691# Select Committee on Small Business (U. S. House).
ENERGY CRISIS AND SMALL BUSINESS
GPO Washington 1973 65 p refs Presented to Select Comm. on Small Business, 93d Congr., 1st Sess., 13 Jul. 1973
Avail: Select Comm. on Small Business

Results are presented of an investigation of the petroleum industry made by the Federal Trade Commission. The investigation looks into the growing shortage of gasoline and its effects on small businesses, especially the independent gas station operator. The origins and nature of the present gasoline shortage can only be understood with reference to the structure, conduct and performance of the entire industry. The focus of the discussion includes: background and methodology of the current petroleum investigation; structure, conduct, and performance of the petroleum industry; and Committee staff conclusions. A.L.

N74-14692# Committee on Commerce (U. S. Senate).
ENERGY RESEARCH AND DEVELOPMENT, 2
Washington GPO 1973 166 p Hearing on S. 357 before Comm. on Com., 93d Congr., 1st Sess., 1 Mar. 1973
Avail: Comm. on Com.

A Congressional hearing was conducted to establish a Federal power research and development program to increase efficiencies of electric energy production and utilization, reduce environmental impacts, develop new sources of clean energy, and reduce the use of fossil fuels. The various features of the energy bill are: (1) establishment of a Federal Power Research and Development Board, (2) establishment of a trust fund, (3) authorization of a research program, and (4) definition of penalties for failure to comply with the provisions of the act. The report consists primarily of testimony by witnesses concerning the utilization of energy and new energy sources. Author

N74-14693# Committee on Commerce (U. S. Senate).
NATIONAL FUELS AND ENERGY CONSERVATION ACT OF 1973
Washington GPO 1973 177 p refs Rept. on S.2176 presented by Comm. on Com. at the 93d Congr., 1st Sess., 16 Nov. 1973
(S-Rept-93-526) Avail: US Capitol, Senate Document Room

The National Fuels and Energy Conservation Act of 1973 is reported. The purpose of the bill is to declare a national policy of conserving energy resources through more efficient conversion and use, to make energy conservation an integral part of all programs of the Federal Government, and to encourage an energy conservation ethic among American industry and the consuming public. The methods by which these goals are to be achieved are specified. Examples of energy consumption by various components of the national economy are provided. Author

N74-14694*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
ANNUAL ADP PLANNING DOCUMENT
M. Mogilevsky 1 Oct. 1973 39 p
(NASA-TM-X-69298; KSC-GP-421F) Avail: NTIS HC $4.00 CSCL 05A

The Category A computer systems at KSC (AI and A2) which perform scientific and business/administrative operations are described. This data division is responsible for scientific requirements supporting Saturn, Atlas/Centaur, Titan/Centaur, Titan III, and Delta vehicles, and includes realtime functions, Apollo-Soyuz Test Project (ASTP), and the Space Shuttle. The work is performed chiefly on the GEL-635 (AI) system located in the Central Instrumentation Facility (CIF). The AI system can perform computations and process data in three modes: (1) real-time critical mode; (2) real-time batch mode; and (3) batch mode. The Division's IBM-360/50 (A2) system, also at the CIF, performs business/administrative data processing such as personnel, procurement, reliability, financial management and payroll, real-time inventory management, GSE accounting, preventive maintenance, and integrated launch vehicle modification status. Author

N74-14695# Oak Ridge National Lab., Tenn.
ELECTRIC ENERGY REQUIREMENTS FOR ENVIRONMENTAL PROTECTION
E. Hirst and T. Healy 1973 20 p refs Presented at Conf. on Energy, Demand, Conserv., and Inst. Probl., Cambridge, Mass., 12 Feb. 1973 Sponsored in part by AEC and NSF Prepared in cooperation with Santa Clara Univ., Calif.
(Conf-730205-4) Avail: NTIS HC $3.00

The amount of electricity needed for (or saved by) operation of several environmental quality strategies is examined. These strategies include: electric mass transit, waste water treatment, solid waste disposal, air pollution control, waste heat dissipation, and electricity conservation. Energy requirements of existing electric mass transit systems are compared with the new BART system, buses, and autos. Electric energy costs, as a function of plant size, are examined for primary/secondary sewage plants. Electricity costs and savings are computed for solid waste disposal, recycle, and use as fuel. Electricity needs for air pollution control at stationary sources and from motor vehicles are evaluated. Electricity needs for use of cooling towers at power plants are reviewed. Finally, potential energy savings which reduce air and thermal pollution levels are examined. The electricity required to meet the needs discussed here-based on the assumptions in this study-are small relative to total kilowatt-hour consumption. Author (NSA)

N74-14696# Army Construction Engineering Research Lab., Champaign, Ill.
A DATA-BASED METHODOLOGY FOR SPECIFYING CONSTRUCTION PROJECT DURATIONS
D. W. Halpin and C. E. DeLong Aug. 1973 25 p refs
(AD-767529; CERL-TR-P-14) Avail: NTIS CSCL 13/2

The report presents a method of determining the construction contract performance times for military construction projects. This method is based on information that is regularly reported as feedback during the execution of a construction contract for military construction, Army projects. By organizing the data from the manpower-utilization feedback reports, a model is formulated and mathematically derived. An example of data reduction is presented, and the results of applying the methodology to these projects are reported. A proposal of implementation of the methodology in U.S. Army Corps of Engineers, district offices is presented. Author (GRA)

N74-14697# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
FY 74 TECHNICAL OBJECTIVE DOCUMENT
B. Chasman Apr. 1973 38 p
(AD-768312; AFML-TR-73-35) Avail: NTIS CSCL 05/2

The Technical Objective Document was prepared by the Air

Force Materials Laboratory (AFML) and describes the Materials Technology Planning Objectives (TPO's) for meeting future Air Force operational needs. The six Technology Planning Objectives encompass the full spectrum of materials capabilities required for future aircraft, missile, space and electronic systems. Thermal Protection Materials, Aerospace Structural Materials, Aerospace Propulsion Materials, fluid, Lubricant and Elastomeric Materials, Protective Coatings and Materials, Electromagnetic Materials. Presented for each TPO is the general objective, specific goals and technical approaches, and a Laboratory TPO focal point who can facilitate face-to-face discussions with Laboratory engineers and scientists. This report supersedes TOD 71-26.

Author (GRA)

N74-14698# Massachusetts Inst. of Tech., Cambridge.

TECHNICAL-ECONOMIC CONSIDERATIONS IN PUBLIC SERVICE BROADCAST COMMUNICATIONS FOR DEVELOPING COUNTRIES

Robert C. Butman, Georgy W. Rathjens, and Colin J. Warren 1973 332 p refs Prepared for Acad. for Educational Develop., Inc., N. Y.

(Contract AID/CSD-2829)

(PB-223266/8GA; Rept-9) Avail: NTIS HC $7.25 CSCL 05I

An inquiry into the distribution of educational material in developing countries is presented, with particular attention to the problems and opportunities in Brazil and India. Emphasis on the use of television and satellites to distribute T.V. programming is a reflection of the interest in the use of satellite-T.V. systems in two countries. The report includes techno-economic factors, cost and policy considerations, comments on expanding radio and television broadcasting services in Ethiopia, and technical aspects of educational communication technologies. GRA

N74-14699# Daniel, Mann, Johnson and Mendenhall and Associates, Los Angeles, Calif.

PHASE ONE REPORT: CALIFORNIA MASTER PLAN OF AVIATION, STATE OF CALIFORNIA

Apr. 1973 123 p Sponsored in part by HUD

(Contract DOT-FA72WE-1705)

(PB-222839/3; CALIF-AERO-7; QPR-2) Avail: NTIS HC $8.25 CSCL 13B

The report summarizes the consultant's findings, conclusions and evaluations and provides his preliminary recommended plan to serve as a basis for the development of the Air Carrier System in California. The plan includes four proposed new air carrier airports. The report contains: descriptions of air carrier and general aviation models developed in the study; tabulations and illustrations of aviation data inventories; forecasts of air travel demand and supply; and evaluation of alternate airport systems. GRA

N74-14700# Naval Research Lab., Washington, D.C.

NRL PROGRESS REPORT, MAY 1973

May 1973 62 p refs

(PB-223053/0) Avail: NTIS HC $3.00; also available on subscription $22.50/year domestic, $28.25/year foreign CSCL 05B

The research activities of the NRL are reported. Two articles are presented. These are space science research in 1973, and high energy astronomy. Areas in which progress is reported include: acoustics, communications, electronics, metallurgy, oceanology, and radar. F.O.S.